What's New For The 64

COMPUTE!'s GAZETTE

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April 1985
Issue 22, Vol. 3, No. 4
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The Winter Consumer Electronics Show

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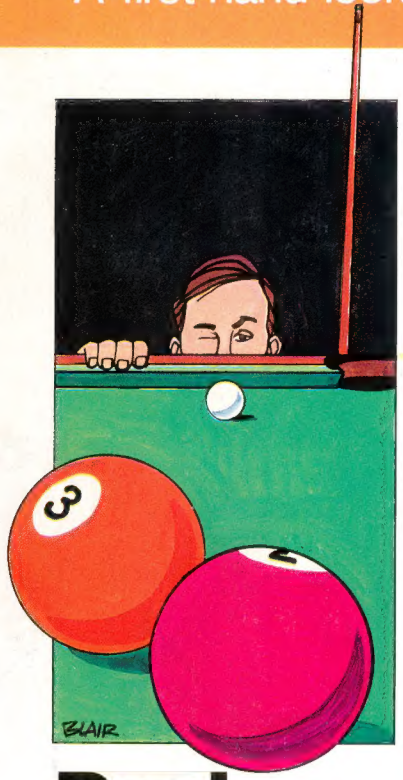

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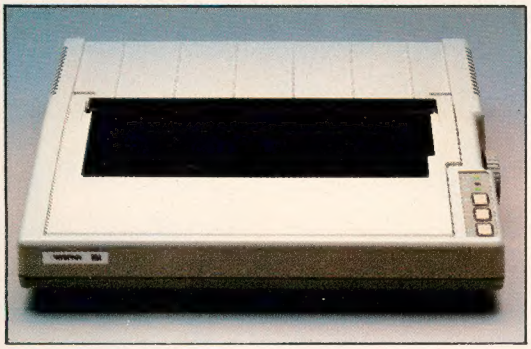
(COLUMN WIDTH)							
40 CHARACTERS PER LINE	YES	40 CPL	YES	YES	YES	YES	YES
80 CHARACTERS PER LINE	YES	80 CPL	YES	YES	YES	YES	YES
66 CHARACTERS PER LINE	YES	66 CPL					
132 CHARACTERS PER LINE	YES	132 CPL					
(PAPER HANDLING)							
FRONT LOADING FOR EASY PAPER SETTINGS	YES						
BUILT-IN PRINTER STAND	YES						
PRINT ON POST CARDS	YES						
(WARRANTY)							
ONE-YEAR WARRANTY	YES						
(SOFTWARE COMMANDS)							
DOUBLE STRIKE	YES	DOUBLE STRIKE					
EMPHASIZED	YES	EMPHASIZED					
COMPRESSED	YES	COMPRESSED					
UNDERLINE	YES	UNDERLINE					
SUPER/SUBSCRIPTS	YES	SUPER SUB SCRIPTS					
ITALICS	YES	*ITALICS*					
DOUBLE DENSITY BIT IMAGE	YES						
(CHARACTERS)							
9X9 FONT	YES						
TRUE DISCENDERS	YES	abcgjpqyabc					
ITALICS	YES	*ITALICS*					
COMMODORE GRAPHICS	YES		YES	YES	YES	YES	YES
(OTHER FEATURES)							
SINGLE DENSITY BIT IMAGE	YES		YES	NO	YES	YES	NO
EXPANDED	YES	EXPANDED	YES	YES	YES	YES	YES
REVERSE	YES	REVERSED	YES	YES	YES	YES	YES

NO

RITEMAN R64



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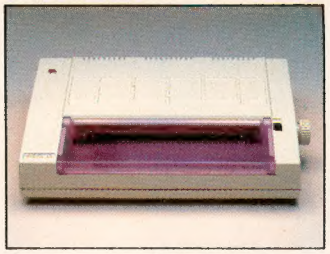

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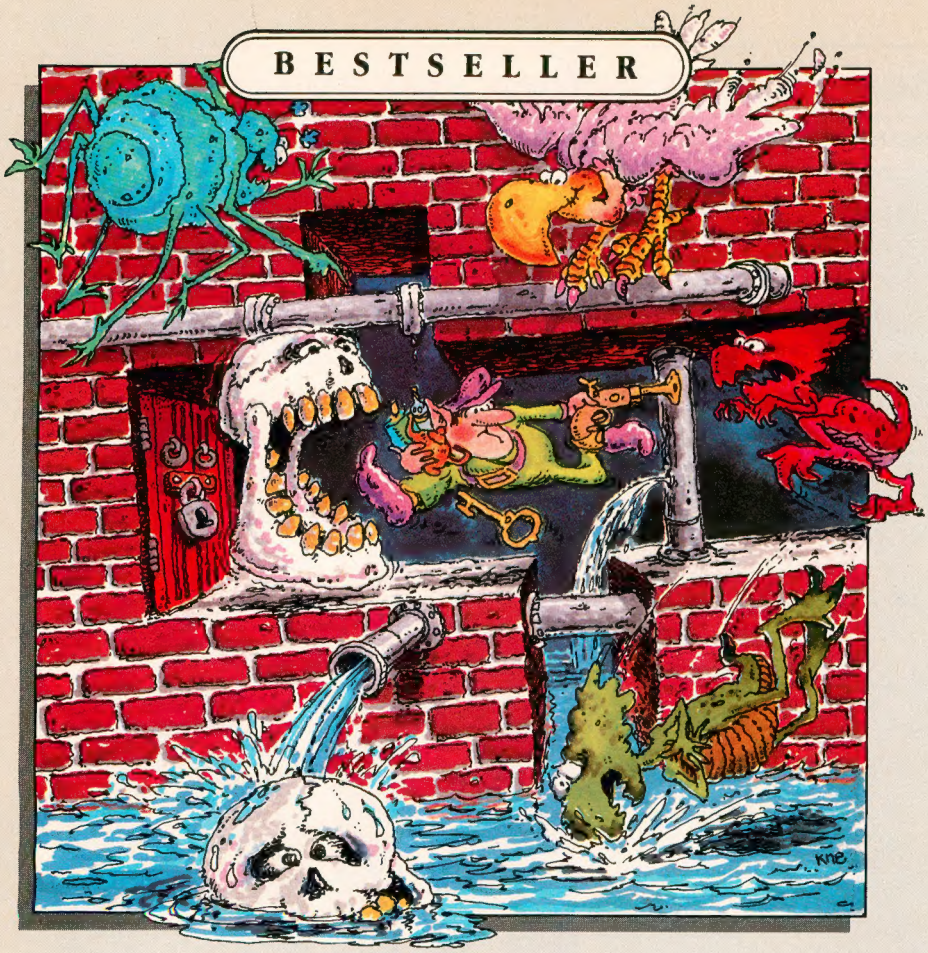

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THE EDITOR'S notes

This month, Senior Editor Richard Mansfield discusses the two main approaches to programming.

–Robert Lock, Editor In Chief

An intriguing letter arrived here this week from the chairman of a high school computer department. He said that our magazines would not be used in his department because one of our published programs was not correctly written. The offending program, "Utility Bill Audit," was printed in a circulation flyer. His complaint centered on the style of programming. For one thing, the program contains no REM statements, no internal comments explaining the purpose of each line of the program.

He goes on: "There's (sic) so many GOTO and GOSUB statements . . . if any of the over 1,000 students in our district's Computer Studies Department ever submitted a program so sloppy . . . so unstructured and so undocumented, they (sic) would be sure to receive a failing grade."

The educational community has an important task: to prepare the minds of the next generation. Many teachers approach this difficult job with great skill and insight. Others, unfortunately, get lost in minutia, preferring to make easy judgments and present to their students an unpleasantly narrow, pinched reality, a one-dimensional world.

A computer program can be judged by a variety of criteria: speed, general usefulness, memory efficiency, programming cleverness, beauty of design, ease of modification, and clarity.

Obviously, the needs of the classroom differ somewhat from the needs of a magazine. "Utility Bill Audit" is an especially useful applications program. Size is always a consideration in magazines. It's of particular importance when trying to fit something useful into the small space available in a subscription advertisement mailing. In these contexts, a program's compactness is of great value. REM statements would have perhaps doubled its size.

All our published programs, this one included, are documented in the text of an accompanying article. However, when a program contains no particularly novel or complex programming technique, REM comments are omitted. It would serve no meaningful purpose to REMark about the unremarkable. Our readers would quickly tire of repetitive explanations of perfectly obvious FOR/NEXT loops or DATA statements within published programs. Elementary BASIC programming is thoroughly covered in several of our regular columns.

But the essence of this gentleman's complaint about "Utility Bill Audit" is that it makes use of too many GOSUB and GOTO instructions. These instructions interrupt the straightforward execution of a program; they cause it to branch to different places while running. The program works correctly—a person using it wouldn't know whether or not there were "too many" GOSUBs. However, using branch instructions does make it less easy to follow along from one event to the next if you are trying to *read* the program, to understand how it works (or to give it a grade in school).

Some teachers, even some programming languages, forbid the use of the GOTO instruction. The argument is that this kind of branching creates programs which are hard to correct, hard to understand, and hard to modify. They can jump all over the place: events don't occur in a series A B C D, etc. Rather, the structure might look like this: A B D C because between B and C there was a GOSUB which inserted D in the otherwise simple progress through the alphabet.

This argument has some merit. Yet few programmers would willingly give up GOSUB and GOTO; they are among the most powerful and frequently used commands in BASIC. Even fewer are willing to spend the time typing in REM comments except to describe major sections of a program or clarify obscure code.

There seem to be two distinct programming styles: improvisational and architectural. Schools and many professional programming teams support the architectural style: many formal rules of behavior, extensive diagraming, preplanning, and highly structured, heavily commented programs. The resulting programs take much more time to write, but they communicate their methodology and logic more quickly to another programmer, to a programming committee, or to a teacher attempting to assign them a grade.

By contrast, the improvisational style is favored largely by independent, recreational, or sophisticated creative programmers. This style stresses hands-on, free-form program design. Comments are often replaced with meaningful variable names and GOTO is used with abandon. For these people, what a program does is generally more important that how it's done. They create a list of instructions for the computer to obey, not a list of structures for another programmer or teacher to read and study. The improvising programmer rarely designs his or her program in advance. Instead, communication with the machine is direct and interactive.

COMPUTE! Publications offers both styles of programming in its books and magazines. Some programs are heavily commented and their structure reflects an architecturally strict design. Others are freer, not particularly interesting as *programs* perhaps, but of significant value in the application they offer the user. "Utility Bill Audit" is one of the latter.

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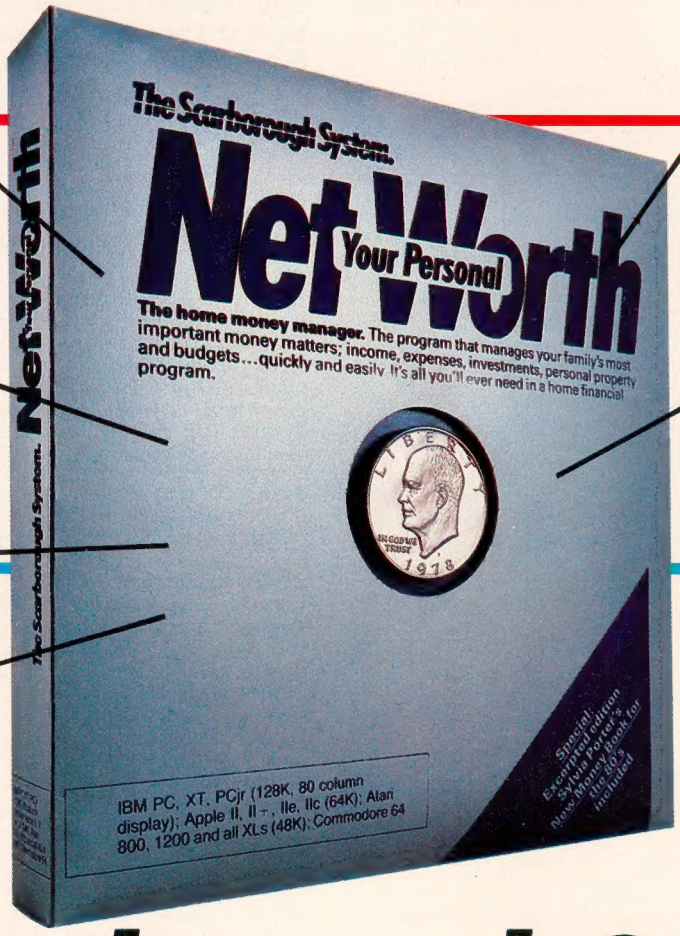
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Building A Computer System

I recently received a Commodore 64 as a gift. All I have is the computer. I would like to use it for three things: 1) Writing two books—a family history with genealogy and a church history. Both require extensive indexing and cross-referencing of names and places. 2) Correspondence (I write a lot of letters). 3) Keeping a set of books for a small business.

I am not inclined to write programs or play games, but would like a simple approach to keeping personal and household records.

Dan O. Harvill

In addition to the 64, you'll need some hardware. A computer by itself isn't especially useful. Computer memory is volatile, *which means when you turn your 64 off, all the information in memory is lost. The first thing you should purchase is some sort of mass storage device—a tape or disk drive—so you can save programs and files for later use. For your purposes—accounting and recordkeeping—a disk drive would be better, although you could get by with a cassette drive. A printer is essential, too, if you want to print your books and letters.*

You have definite ideas about how you'll use the 64, so the hardware you purchase will depend on the software you decide on.

You don't want to learn programming, and you probably don't want to pay the high expense of hiring someone to write custom genealogy and church history software. That leaves commercial software.

A database management program will cross-reference and index both the family tree and the church history. Think of it as a fast electronic card file. You tell the computer what categories to use in the database (for a family tree, you might pick first and last name; dates of birth, marriage, and death; generation number; father, mother, spouse, and children; and so on). You then type in the information and save it to tape or disk. The database management program then alphabetizes or sorts by category. You can search for specific entries, and organize the information in different ways, depending on the capabilities of the software.

To write letters and books, you'll need word processing software. If you buy the right word processor, you can merge information from the database into your manuscripts. This might seem like a frill, until you contemplate the extra work of first typing the data into the database and then retyping it into your word processor. There are several packages available which contain both a word processor and database (see "The Move Toward Integrated Software" in the January 1985 GAZETTE*).*

And there are several packages for the 64 that can handle your accounting. In this case, compatibility with the other two programs is probably not necessary.

How do you decide on the hardware and software you need? That's up to you. We can't recommend specific items; each has its strengths and weaknesses. If you're far from a Commodore dealer, you can write directly to manufacturers. Or read the ads and reviews in computer magazines. User groups are often helpful sources of information, too.

The Best Tape Is Also Less Expensive

I'm stationed in the Phillipines and just about everything having to do with computers is expensive. I'm looking for a good, inexpensive tape for saving computer programs. I do a lot of audio recording and like to use CrO_2 tape. Will chromium oxide tape (high position) damage my Datassette?

G.O. Starr

It won't damage your cassette drive, but you won't get the best results from it either.

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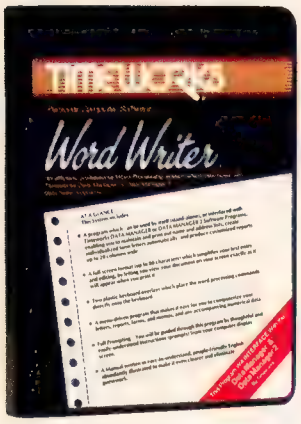

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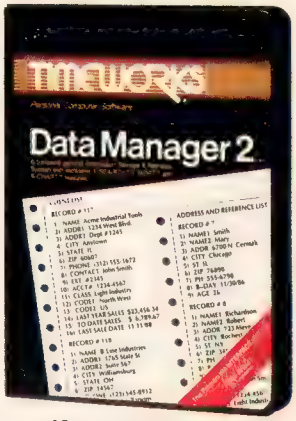

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may have problems using chromium tape with your system.

Not only is ferric oxide tape better for use with a computer, it's also less expensive. Buy the shortest tapes you can find; long tapes (90 or 120 minutes) are often thinner and can lose tension, leading to slippage. Also, to maintain recording quality you should regularly clean and demagnetize the heads on your Datassette.

A 16384K Expander For The VIC And 64?

I recently read a couple of articles describing a new chip called the 65816. Apparently this chip has enormous potential and might also be instantly interchangeable with the 6502. Do you have any further information? What will it mean for users of Commodore, Atari, and Apple?

Bill Pittman

The chip that runs the Apple, Atari, and the VIC-20 computers is the 6502. The 64 uses the 6510, from the same 65xx family of microprocessors. The 65xx chips can address up to 64K (65,536) of memory and no more, because they have a 16-bit address bus.

This new chip has a 24-bit address bus, which lets it access 256 times as many memory locations—16384K (16 megabytes). It's the same size as the 6502, and pin-compatible. The machine language instruction set is upward-compatible from the 65xx processors. The 65xx ML opcodes are all there, and there are more (including an extra register, another status flag, and useful instructions like PHY and TXY).

It runs in two modes: 8-bit (6502-compatible) and 16-bit, and you can toggle back and forth between the two.

Several readers have written for information about replacing the 65xx chip in their VIC or 64 with the 65816. Contrary to some published rumors and speculation, you can't add extra memory that easily. You'd have to add another timing clock (chip) and redesign the circuit board to accommodate the extra memory and support chips. In short, you'd have to completely revamp the internal layout of the computer, a job best left to engineers. A hard disk drive would almost be a necessity—16 megabytes is the equivalent of nearly 100 floppy disks.

If computer companies decide to use the 65816 in their new machines, they could offer memory expandability (up to 16 megabytes) and *complete compatibility with Apple, Atari, or Commodore. So far, Commodore has not announced any plans to build a computer around the 65816. They're designing the Amiga around the 68000, the same chip used in the Macintosh. Apple is said to be thinking about putting the 65816 in a new Apple II compatible.*

Managing Memory And Dangerous POKEs

I have a problem with a program which contains six sprites. It loads and runs once. On the second run I get either a strange line number which bombs the program or I lose the sprite data lines, causing an OUT OF DATA error.

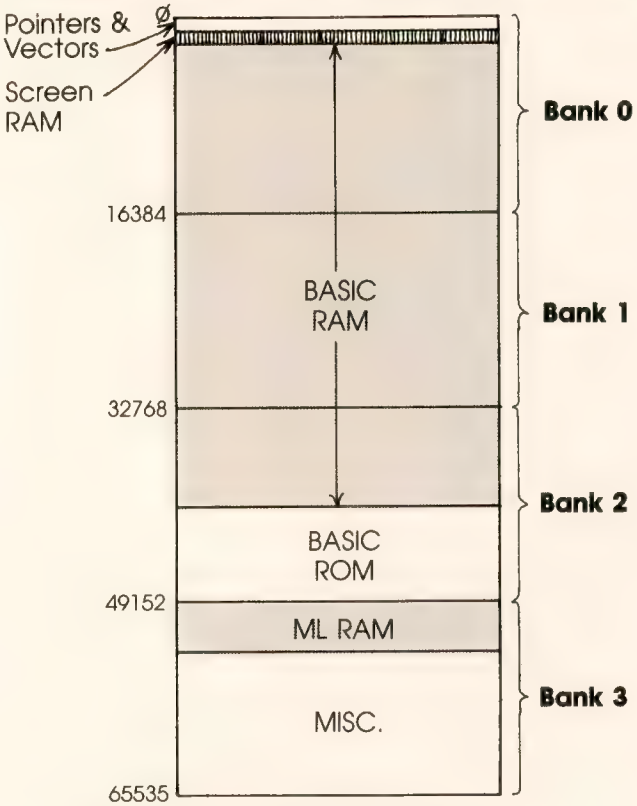
I believe the variables are overwriting the sprite area. I have 29923 bytes free before running, 29633 free after running. After reading many reference books, I've gotten ideas about moving, hiding, raising, and lowering memory, and I've come to the point where I can't see the forest for the trees. I'm missing something somewhere.

Donald M. Hewitt

Sprites need memory. Your program and variables also need memory. Although you have plenty of free memory, it sounds like your sprites are interfering with program memory.

In general terms, the 64's memory runs from locations 0 to 65535 and is divided into these sections:

Simple Commodore 64 Memory Map



0–1023	**stack, pointers, and vectors**
1024–2039	**screen memory**
2040–2047	**sprite pointers**
2048–40959	**free memory for BASIC programs and variables**
40960–49151	**BASIC interpreter**
49152–53247	**free memory for machine language programs**
53248–65535	**miscellaneous (video, sound, color memory, Kernal)**

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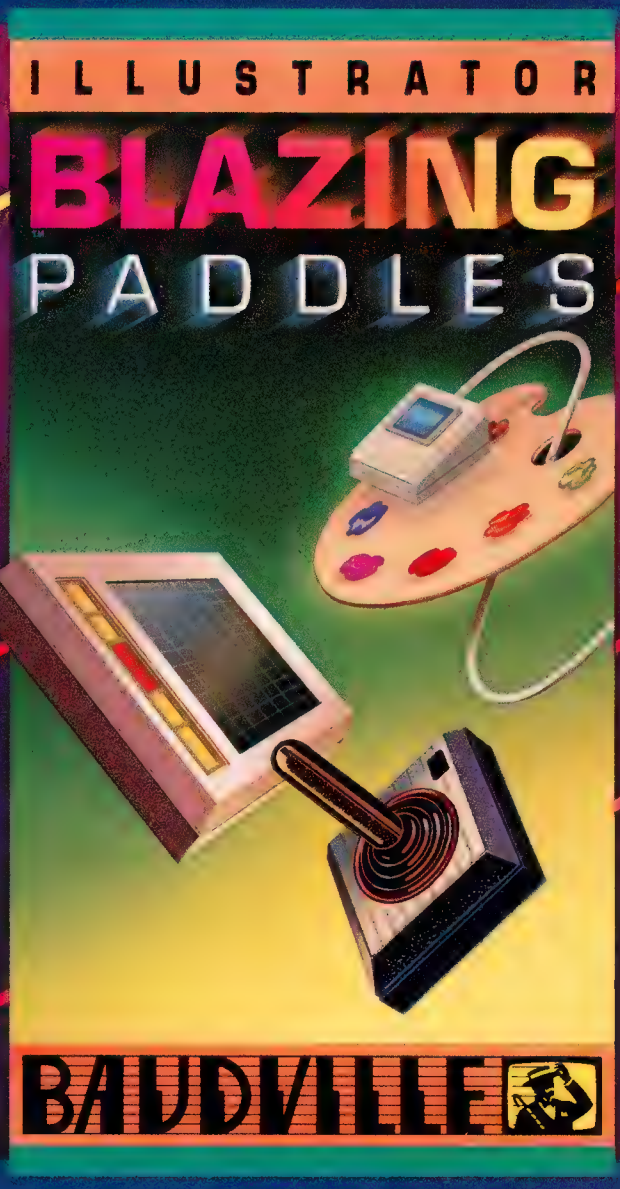

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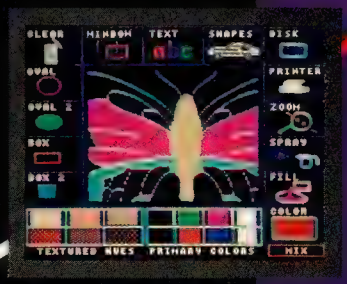

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The shaded areas indicate free memory you can use for your programs.

*BASIC programs are stored in memory starting at 2048. To find out where the program ends, type PRINTPEEK(45)+256*PEEK(46). When you run a program, the variables are stored just past the end of the program. To find out where the variables and arrays end, PRINTPEEK(49)+256*PEEK(50) after running the program.*

If you use these two formulas, you'll probably find that your sprite definitions are being put into memory already used by your program. POKEing sprite data into program memory scrambles part of the program, making it crash the second time around.

You have two choices: Move the sprites somewhere else, or change the start of BASIC to somewhere above the sprite definitions.

The VIC-II chip controls the video signal which draws the screen characters and sprites. It can access any memory location within a 16K block or bank of memory. These banks are labeled 0–3 on the abbreviated memory map above. When you turn on the 64, the VIC-II chip takes its information from bank 0. It's possible to switch to other blocks by POKEing to 56576, but you also have to move screen memory and character memory, which means copying character ROM down to RAM. Thus, moving sprite definitions to another 16K bank is rather complicated.

*It's much simpler to move BASIC up, completely out of bank 0. Before loading your program, POKE642,64:SYS58260 to move the start of BASIC to 64*256 (16384), the beginning of bank 1. You'll still have 24K for your program, and it won't interfere with the sprites. There will be 14K (from 2048 to 16383) for the VIC-II chip. You can use this memory for an 8K hi-res screen, redefined characters, or up to 224 sprite shapes. Remember to use this POKE and SYS* before *loading your BASIC program.*

The Eddie Operating System

I wrote this program for the 64 using Micromon and *COMPUTE!'s Mapping The 64*. It changes the all-too-familiar *READY.* prompt to *EDDIE!*, copying BASIC ROM to RAM at the same address and then changing the pointer at location 1 to recognize the RAM. If you press RUN/STOP–RESTORE, READY will come back, but you can reenable the customized prompt with POKE1,PEEK(1)AND254.

```
10 FORJ=40960TO49151:POKEJ,PEEK(J):NEXT
20 POKE1,PEEK(1)AND254
30 FORJ=41848TO41853:READL$:POKEJ,ASC(L$)
   :NEXT
40 DATAE,D,D,I,E,!
```

Edward Padin

Readers who want to substitute up to six letters in place of READY can change the DATA statement in line 40 (separate the letters with commas). The program takes 30–40 seconds to run.

This is a good example of how to use the RAM underneath ROM. The BASIC interpreter is found in Read Only Memory (ROM) at locations $A000–BFFF (40960–49151). At the same locations is 8K of Random Access Memory (RAM), which is usually not used by the computer. BASIC can access one but not both of the 8K blocks of memory at any one time. ROM is permanent, but RAM is changeable. When you PEEK within this range, you get the numbers in ROM, but POKEing puts numbers into the RAM "underneath" ROM. Line 10 seems to PEEK a location and POKE the same number right back, but really copies BASIC down to RAM, where it can be altered.

Line 20 flips a bit in location 1 to make the computer look at the RAM underneath, rather than BASIC ROM. This technique is called bank switching, *because one 8K bank is switched out, another switched in. An exact copy of BASIC has just been put there, so everything works the same, until some new values are POKEd into the area where the READY prompt is stored.*

Machine language programmers sometimes use this technique to rewrite BASIC to fit their needs. And if you don't need BASIC at all, this technique gives you another 8K of memory for ML programming.

For another example of changing BASIC messages, run the above program and then POKE41654,72:PRINT4/0. You'll see an error message, DIVISION BY HERO (instead of ZERO).

Alphabetizing A List

I am trying to take seven words from DATA statements and put them into an array so I can print them in A-B-C order. I get the first word in the right order but not the other six. How do you sort a list and keep the information intact?

Kurt Wells

You're on the right track because you're using an array and have the first word in the correct place.

A one-dimensional string array is like a numbered list of words. String arrays make it much easier to alphabetize. Because each item has a number, you can use a FOR-NEXT loop to search through the list. To sort, you compare the first word to the second, trade them if they're out of order, compare item two to item three, trade if necessary, and so on until you reach the last entry on the list. If the program loops through the array once, one word will be in the correct place. If you loop twice, the second entry will be in the right place.

Less-than, greater-than, and equals are commonly used to compare numbers (for example, IF SC>HS THEN PRINT "NEW HIGH SCORE!"). But

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they can also be used to compare strings. The computer decides if a word is "less than" another by comparing the ASCII values. The letter A is less than B, which in turn is less than C. An appendix at the end of the User's Guide contains a complete list of Commodore ASCII codes.

Here's a program that alphabetizes a list of five strings:

```
10 TN=5:{3 SPACES}REM TOTAL NUMBER OF ITE
   MS
20 DIMA$(TN)
30 FORJ=1TO5:READA$(J):NEXT
40 REM ALPHABETIZE
50 FORJ=TN-1TO1STEP-1
60 FORK=1TOJ
70 IFA$(K)<A$(K+1)THEN90
80 TEMP$=A$(K):A$(K)=A$(K+1):A$(K+1)=TEMP
   $
90 NEXTK,J
100 REM PRINT THE ALPHABETIZED LIST
110 PRINTCHR$(147)
120 FORJ=1TO5:PRINTA$(J):NEXT
130 DATAOF,STRINGS,ARRANGED,LIST,ALPHABET
    ICALLY
```

Lines 10–30 set up the array, DIMensioning to a size of five and READing the words from the DATA statement. Lines 50–90 alphabetize the list and line 120 prints the list in order.

The outside loop uses the variable J and starts in line 50. It counts backwards (STEP −1) from one less than the array size (TN − 1) to 1. So variable J begins at 4 and counts down to 1. The inside loop uses K and counts forward to J: 1 to 4, then 1 to 3, 1 to 2, and finally 1 to 1. Line 70 compares A$(K) to A$(K+1), the next string on the list. If word K is less than word K+1, they're in order and the program skips to line 90. If not, line 80 swaps them.

The strings start out in this order:

A$(1) OF
A$(2) STRINGS
A$(3) ARRANGED
A$(4) LIST
A$(5) ALPHABETICALLY

After the first pass (J=4), STRINGS drops to position 5, but the other four words are still out of order. The second pass (J=3) puts OF in its proper place, and so on.

This algorithm is called a bubble sort. One advantage of bubble sorting is that it's fairly simple and straightforward. The major disadvantage is its inefficiency; it works very slowly with large lists. To bubble sort five items requires ten comparisons, but multiply the list size by 20 (100 items) and the number of comparisons increases by a factor of 495 (4950).

There are faster methods to alphabetize, but they're more complicated to program.

No BBS For VIC?

In the December issue, you published the "C/G Bulletin Board" for the 64 but not for the VIC-20. Why? I have 35K memory for my VIC, which would be plenty of memory for the bulletin board. I don't understand why you bothered to publish C/G Term for the VIC if you had no intention of giving VIC users a bulletin board.

Harry C. Phillips

There were several considerations in our decision to publish the bulletin board for the 64 only. Most important, the Commodore 1650 Automodem offers auto-dial, but not auto-answer for the VIC, a must for operating a bulletin board. You'd have to sit by the phone, ready to answer calls to the BBS. You can use the auto-answer feature with the 64. The VICmodem has no auto-answer or auto-dial feature, making it inappropriate for a bulletin board.

Also, the program length was unwieldy enough for the 64—it took a lot of magazine space in two issues (December and January). A VIC version would have required just as many pages (leaving less room for columns, games, and programs).

With 35K, you certainly would have enough memory, but VIC owners with that much memory are an exception rather than a rule. The 22-column VIC screen also makes the reading of lengthy text (what you see most often as a BBS operator) very cumbersome.

The VIC version of "C/G Term" allows VIC owners to communicate with the "C/G BBS" and with either 64 or VIC owners who have "C/G Term."

Which Is More Random?

It has been demonstrated to me that INT(RND(1)*X) is inferior to INT(RND(0)*X) in generating a true sequence of random numbers. The programs you publish use the first formula. In light of this information, is there any reason to continue to do so?

Rob Landeros

The idea that RND(0) yields more randomly distributed numbers is mistaken. The argument for RND(0) usually goes something like this: Turn on your computer and type PRINTRND(1) and write down the number. Turn the computer off and then on and do it again. You'll get the same number every time. In fact, if you print a series of RND(1)s, the sequence will always be the same. Thus, RND(1) is not truly random. With RND(0), the numbers seem to be more random.

We have seen published "proofs" similar to the argument above. But RND(0) has some serious flaws. Enter the following program (for the 64 only):

```
10 PRINT"{CLR}":POKE53281,1
20 FORJ=1TO1000:K=INT(RND(0)*1000):POKE55
   296+K,6:POKE1024+K,160:NEXT
30 GOTO30
```

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Line 20 generates 1000 random numbers ranging from 0 to 999 and then POKEs a reverse space to the corresponding screen location. You can see a definite pattern with RND(0). If you change the RND(0) to RND(1), there is no such pattern. RND(1) gives you a wider range of numbers, distributed more randomly.

The RND function is not truly random, it only seems to be. It takes a number (called a seed*), performs some mathematical operations on it, and gives back another number. If you use RND(0), the function is seeded with values from the two CIA Time-Of-Day clocks.*

RND(0) is undesirable for several reasons. One of the CIA clocks starts at zero, and doesn't change until you write to it. So some of the seed values are always the same. To make things worse, the clocks operate in Binary Coded Decimal, which means they count from 0–99 instead of 0–255, further limiting the seed values. With all of these limits on seed values, the distribution of RND(0) numbers is limited.

RND(1) takes the seed from memory locations 139–143. When you turn on the computer, the values in these locations are always the same, which is why RND(1) seems so predictable.

The best way to generate random numbers is to scramble the values in 139–143 using the jiffy clock, which ticks 60 times a second. At the beginning of your program, include a line X=RND(−TI). From then on, use RND(1). The numbers won't be completely random, but you'll have the closest thing to random numbers.

Machine Language Trigonometry

I've been working on some high-resolution graphing in machine language, and have come across a problem. How do you calculate trigonometrical functions like sine and cosine in machine language? I know these locations perform the functions on a VIC-20:

COS	**$E261**
SIN	**$E268**
TAN	**$E2B1**
ATN	**$E30B**

How do you call these functions? For example, how could I find the sine of 30 degrees?

David Reid

When you're stuck on a programming problem, it sometimes helps to step back and think about it from a distance. Very often, the best method of doing something in BASIC is also the best method in ML—but not in this case.

To find the sine of 30 degrees, you could JSR (Jump to SubRoutine) to $E268. This is the address on the VIC-20; on a 64 the equivalent routines are all three bytes higher—sine would be at $E26B. The routine acts on the number in the Floating Point Accumulator, locations $61–66, and stores the result there. But it expects you to describe the angle in radians, not degrees. And the answer is almost always a floating point fraction.

To change degrees to radians, you have to divide by 180 and multiply by π *(approximately 3.14). It becomes quite complicated to find the sine of 30 degrees in ML: Convert 30 to floating point, convert 180 to floating point, call the floating point division routine, transfer* π *to the second floating point accumulator, call the floating point multiplication routine, and (finally) JSR to the sine function.*

The result is a fraction in floating point format, which is not especially useful in a machine language program. Also, because you're using BASIC routines, this part of your program will not run much faster than a BASIC program. You might as well do the calculations in BASIC, reserving machine language for plotting the points on the hi-res screen.

There's a good alternative, though: a machine language data table. The sine of an angle from 0 to 90 degrees will always range from 0 to 1. Fractions are difficult to handle in ML, so we'll multiply by 255 to get a number between 0 and 255. Write a BASIC program that loops from 0 to 90, figures out the sine of the angle (changed to radians), multiplies by 255, and POKEs the number into a free section of memory, perhaps the cassette buffer. Then, to find the sine of 30 degrees in your program, you would use two instructions: LDY #$1E:LDA $033C,Y. The Y register is an offset used to look up the sine of any angle from 0 to 90 degrees. When you plot the points on the screen, remember that the values have been multiplied by 255.

Here's one more idea: Degrees and radians are arbitrary ways of measuring angles, so why not make up your own system? 256 is a good machine language number; divide a circle into 256 equal parts and invent a new system of trigonometry based on computer angles—it could greatly simplify things.

Replacing Old 1525 Ribbons

In the past you have published information about parts for the 1520 and MPS-801.

I have found another tip for those of us with Commodore printers. Radio Shack sells replacement ribbons that fit the 1515/1525 printer, catalog #26-1424 (for the DMP-100 printer).

Edward Shockley

Thanks for the tip. Although Commodore manufactures its own chips and computers, they buy their printers and some other peripherals from other companies. These companies are willing to customize the printer's character set and operating system, but tend to put standard parts (like ribbons)

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The Mysteries Of AND And OR

I see a lot of ANDs and ORs in your magazine that I don't understand. Even after studying the *Programmer's Reference Guide* and many books and magazines, I have not found an explanation. I understand such lines as this:

```
10 IF A=24 AND B=29 THEN 400
20 IF C=40 OR C=52 THEN 400
```

However, in the following lines, the ANDs and ORs are incomprehensible to me.

```
10 POKE 53265,PEEK(53265)AND223
20 POKE 53265,PEEK(53265)OR32
```

Ray Norton

Mathematical functions like adding, subtracting, or multiplying take two numbers and combine them according to certain rules to form a third number. The rules are constant, and therefore can be converted to tables (like the times tables we learned in elementary school).

AND, OR, and NOT are logical *functions which, like math functions, can be expressed in truth tables. For example:*

```
true AND true = true
true AND false = false
false AND true = false
false AND false = false
```

The statement (A AND B) will be true if and only if A is true and B is true. If either one is false, the result is false. IF A=24 AND B=29 THEN 400 is an example of this type of AND.

But computers can't handle philosophical concepts like truth and falsity. So, within a Commodore computer, 0 (off) bits represent false and 1 (on) bits are true. This is sometimes called a bitwise AND (because it operates on on/off bits rather than true/false statements). Ask your computer to PRINT72AND45. The answer should be 8, as you can see when you convert the numbers to binary:

```
      01001000   72   (64+8)
AND   00101101   45   (32+8+4+1)
      --------
      00001000   8
```

The result contains a 1 only in the position where both numbers have a 1. If you prefer to think of true and false, convert 72 to FTFFTFFF instead of 01001000.

The logical OR operation is true if either statement (or both) is true. Drawing a truth table shows that the only way to get false is if both statements are false. A bitwise OR operates on individual bits:

```
      01001000   72
OR    00101101   45
      --------
      01101101   109
```

If a bit in either number is turned on (or true), the corresponding bit in the result is on.

The third logical operator, NOT, makes true statements false, and vice versa. Because of the way numbers are stored in memory, a bitwise NOT adds one and changes the sign. PRINTNOT5 and the screen displays −6.

You can AND, OR, and NOT numbers from −32768 to 32767.

The examples you gave use AND and OR to turn one bit on or off in a register that determines whether or not the 64 is in high-resolution mode. Normally, the location 53265 contains the number 27. POKE 53265,PEEK(53265)OR32 *turns on bit 5 (the sixth bit from the right).* POKE 53265, PEEK(53265)AND223 *turns it off.*

Programmers often refer to this use of AND as "masking" a byte. The value is selected carefully—placing 1 bit where no change is wanted and 0 bits in positions to be zeroed. This is similar to a painter sticking masking tape to areas that won't be painted.

BASIC evaluates a line like IF A=32 AND B=29 THEN 100 by assigning a value of 0 (false) or −1 (equivalent to NOT 0, or true). You can see how this works by typing A=32:PRINT(A=32). The screen should say −1, meaning (A=32) is true.

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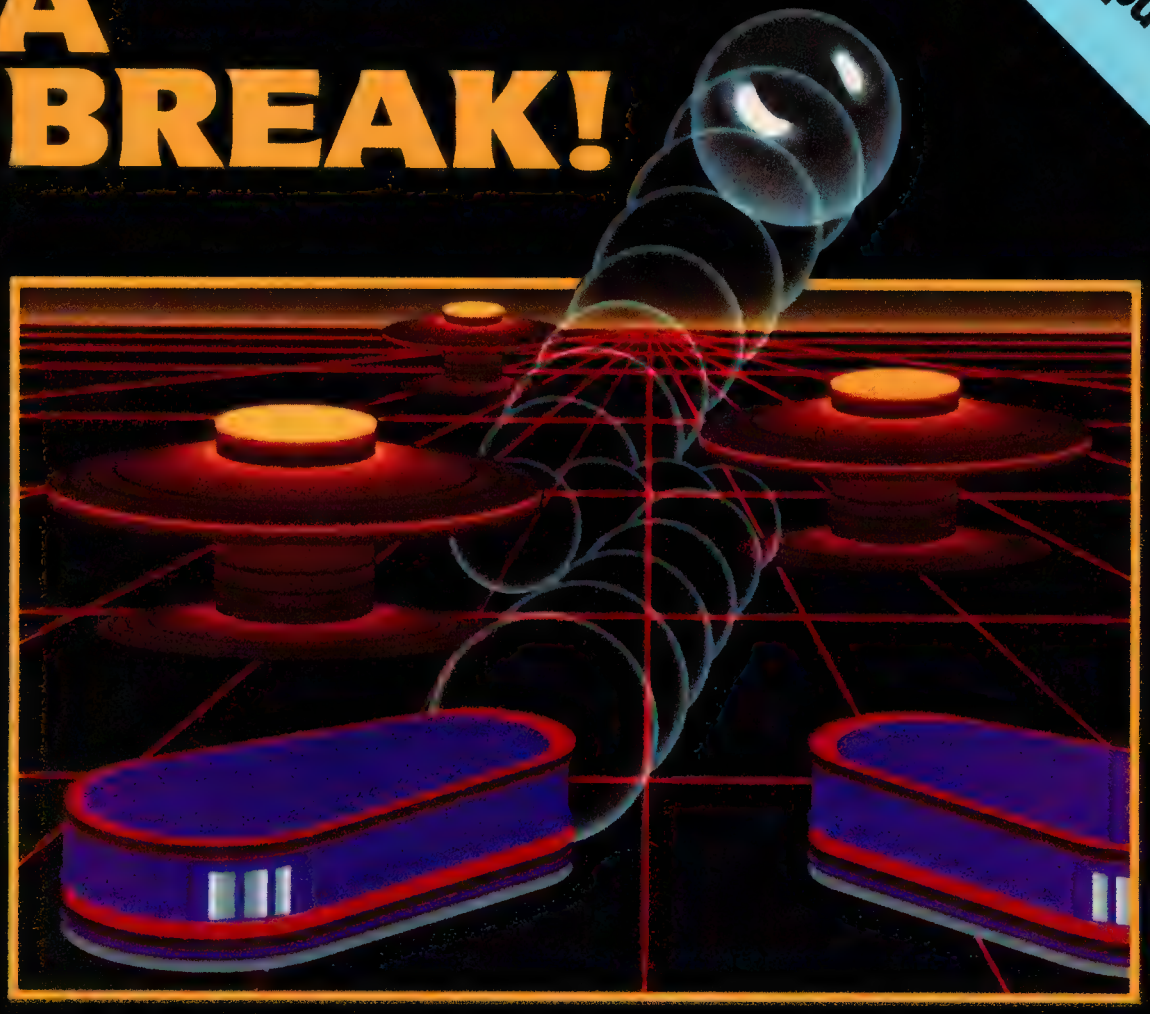

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Lance Elko, Editor

Just when the doomsayers were looking like soothsayers, the home computer industry received a terrific boost from the two remaining "low end" manufacturers, Commodore and Atari, at the Winter CES. The new micros of 1985 redefine the market by bridging the gap between "personal" office computers and home computers.

A giant leap forward is what some observers called this year's Winter Consumer Electronics Show. Unlike the trade shows of the past two years, this CES, held January in Las Vegas, showcased some remarkable new personal computer technology. Industry watchers had been anxiously awaiting new machines. Surely, it was hoped, Commodore would offer some significant hardware, something more promising than the Plus/4 and the 16. And what of Jack Tramiel, founder of Commodore, now head of Atari? Would he deliver? The recent slump had victimized dozens of hardware and software companies, and contributed to the demise of Coleco's Adam. It could not continue.

The Winter Consumer Electronics Show

CES

New Life In The Home

Illustration by Lee Noel

Computer Market

Driving from the Las Vegas airport into town, it became obvious that this CES would be interesting. Along the way were billboards announcing that we were in "Atari country." And at Commodore's press conference on the opening night, press kits flashing "Bad News for IBM and Apple" were distributed. Despite the tendency towards the pie-in-the-sky advertising hype of many companies in this market, the "bad news" slogans and the swaggering "watch out—we're here" attitude from both Commodore and Atari may not miss the mark by much. The new machines represent a major step in changing the market and in significantly upgrading the way we compute.

Commodore announced two new machines, the 128 Personal Computer—externally expandable to 512K—and the portable Commodore LCD. Although Commodore would not announce prices for the new machines, Frank Leonardi, new vice president of marketing, said that the 128 would probably be less than $300 and the LCD less than $600. Commodore expects to release the 128 in April or May, and the LCD about one month later.

The 128, contrary to earlier reports that it was simply a 64 with an extra 64K of RAM, is being positioned by Commodore as three computers in one: a 64, a 128 with 80-columns and RGB (Red, Green, Blue—so named because it isolates the primary color signals, providing a much sharper picture) output, and a CP/M machine. With three microprocessors—a 6510 (same as the 64), an 8502 chip,

What Is CP/M?

Charles Brannon, Program Editor

CP/M has been available for the 64 for a while now, but many people still don't know what it is or what it does. Commodore 64 CP/M consists of a disk and a plug-in cartridge. The disk contains the actual CP/M software; the cartridge contains a Z80 microprocessor. In effect, the CP/M system turns your 64 into another computer. The new Commodore 128 incorporates a built-in Z80 chip, and comes complete with the CP/M disk.

Why CP/M? The usual answer is that CP/M opens up a world of software, thousands of programs that you can run with the right hardware and operating system. But are these programs worth it? Many Apple owners would say yes. For a while, Z80 cards were the hottest add-ons available for Apples. It seemed logical that Commodore 64 owners would also want this power, at a fraction of the price. But CP/M has not caught on so far, at least in home computing.

The CP/M System

CP/M is an acronym for Control Program for Microcomputers. In essence, CP/M is merely an operating system, primarily a disk operating system. An operating system is the base software for a computer. It takes care of routine system tasks, and provides a link between the computer and any other software you may be running.

CP/M began when Gary Kildall, working for Intel, developed a package of compactly written subroutines for the tiny 4-bit 4004 microprocessor. These useful sub-programs could be used by other programs, simplifying the work of a programmer. As technology advanced, CP/M became a full-blown operating system for the Intel 8080 microprocessor, and was upgraded for the 8080-compatible Zilog Z80 microprocessor. Curiously, Intel, the designer of the 8080, was not interested in CP/M, and gave Kildall the go-ahead to market it on his own. He started up a company called Digital Research. (Digital is still going strong; they recently developed GEM, the Macintosh-like operating environment of the new Atari ST computers.)

Before CP/M, there was no real operating system for these computers, so it was quickly seized upon by most users and manufacturers of Z80 computers. There were no successfully competitive operating systems, and CP/M easily became a standard. Since almost everyone had CP/M, all the Z80 machines had more in common with each other. CP/M made it possible for one program to run on many different computers.

Most Z80 computer systems included a

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which is a slightly enhanced version of the 64's 6510, and a Z80 chip for CP/M—Commodore is "trying to meet everybody's wish list," notes Commodore software engineer Terry Ryan. Commodore 64 owners who upgrade don't lose their software (according to Commodore, over 6,000 commercial titles now exist for the 64), those who want a readable 80 columns for word processing or spreadsheets can use the 128 mode, and CP/M will appeal to those interested in more serious business applications. Getting from one mode to another is simple enough. From the 128 mode, type G064. However, once in 64 mode, you must reboot the machine to get to the 128 mode. According to a Commodore engineer, not a single byte was changed in the Kernal because Commodore wanted perfect compatibility with all 64 software. Since G0128 would even in the smallest way change the operating system, they chose the safer route—turn the machine on and type G0128. CP/M is accessed by inserting the CP/M 3.0 disk (CP/M is a disk-based operating system) which is included with the machine.

The 128 includes a much more powerful BASIC than Commodore owners have seen. Named BASIC 7.0 and accessible only in 128 mode, it's derived from the BASIC 4.0 found in the venerable CBM 8032 model, but adds some new disk commands as well as those of the Super Expander 64. Thus, the tedious POKEs required for sound and graphics on the 64 become unnecessary with this new machine. However, when

keyboard and monitor (or terminal), one or two disk drives, and 48K or 64K of memory. These computers were never designed to be compatible with each other, but CP/M took care of that.

The BIOS

Built into CP/M is a library of sub-programs for performing tasks like printing a character to the screen. Each computer might use a different kind of video display, so some portions of CP/M, the BIOS (Basic Input/Output Subsystem) were customized for each machine, but BIOS acted the same way on every machine. Because of the BIOS, programmers could write their routines to use these universal subprograms instead of directly programming their particular computer's video chip. The program, if written properly, could run on any computer with CP/M. Machine-specific tasks became standardized routines.

A CP/M software market thrived, since developers could write a single program that would run on many different computers. Woe be to the computer that lacked CP/M. Even though the TRS-80 used a Z80, it took the efforts of third-party developers to bring CP/M to this machine. For a while, TRS-80 owners were isolated from the mass market, with a separate, smaller, library of software. CP/M was the leader of the 8-bit world, and most small businesses used Z80 CP/M computers. CP/M machines occupied the niche that the IBM PC and PC clones control today.

Is It Obsolete?

The boom went to bust with the introduction of the IBM PC. CP/M machines just couldn't keep up with advances in hardware and software. Although the IBM PC was not a real breakthrough, it expanded the memory ceiling from 64K to 640K. Disk storage jumped from 100K to as much as 370K (double-sided disks). The faster and more powerful 8088 microprocessor made it easier to write better programs in less time. IBM's open architecture encouraged additional power, as more and more hardware companies enhanced the IBM with add-ons.

The microprocessor used in the IBM could not run CP/M, so a whole new standard was forged. (Digital Research's CP/M-86 was not available in time for the release of the PC, so it failed to establish itself as a standard. Microsoft's MS-DOS, which is much like CP/M, beat out CP/M-86 not because it was better, but because it was first.) The 8-bit Z80 world of CP/M was replaced by IBM's 16-bit 8088 world. Software developers jumped on the bandwagon, and CP/M was put on the

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Rewinding mo.
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Terry B Good idea!
Denise R How about meeting me this Friday in the Star room for a game of Chess?
Terry B Sure. Is 10:00 pm ok with you?

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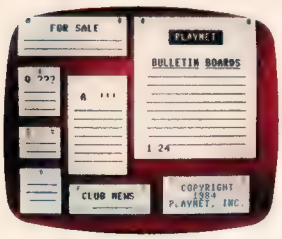

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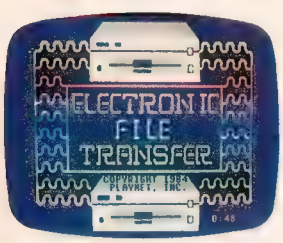

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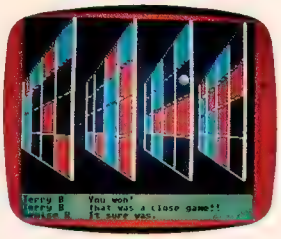

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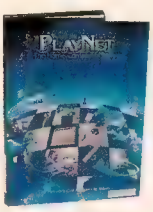

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in 128 mode, either 40 or 80 columns must be selected. With 40 columns, both sprites and the SID chip can be accessed, thus a Commodore 64 with 122K usable RAM. Graphics are not supported in 80-column mode. Also included is a built-in machine language monitor, an expanded version (direct access to disk is available) of the one packaged with the Plus/4.

In offering a more serious and powerful computer, Commodore is also featuring a new

The Commodore 128, "three computers in one," offers a new, more serious look.

back burner.

Since CP/M is no longer the dominant environment for high-end microcomputing (although CP/M machines are still selling today), why is it an issue on Commodore machines? It would seem the best bet would be an IBM MS-DOS emulator, with an 8088 instead of a Z80. Commodore probably went with CP/M because it is built around cheap, proven technology. The Z80 simply costs less than the 8088. And CP/M is more generalized, easier to adapt, than the MS-DOS used on IBM PCs CP/M may be Commodore's way of crossing over from home computing to small business computing. Commodore is even translating some IBM software to CP/M, taking advantage of the similarities between CP/M and MS-DOS.

Most CP/M programs are written in 8080 or Z80 machine language. CP/M takes care of the minor differences between Z80 machines, but you still have to have a Z80 microprocessor. CP/M could be translated to run on any computer, such as the 6502, but what good is a 6502 version of CP/M if all the programs that run under CP/M are written in Z80 machine language?

Commodore CP/M

The CP/M cartridge for the 64 is a Z80 with some control circuitry. It's designed so that it can take control of the 64's memory. When using this cartridge, you're essentially using another computer. The Commodore 64 CP/M BIOS was actually written in 6510 machine language. The Z80 remains in control until it needs to do something like printing a character to the screen, or reading a byte from disk. The Z80 then reawakens the 6510, and puts itself "on hold." The 6510 takes over, finds a request from the Z80, acts on it, then transfers control back to the Z80. It's unusual, but it works.

However, the 64 does not make a great CP/M computer. To get around memory limitations, CP/M resorts to intensive disk access. At the speed of the 1541, this makes programs run quite slowly. Also, most CP/M computers use a 64 or 80-column wide screen. The Commodore 128, with its 80-column screen and high-speed disk interface, may be much more suitable as a CP/M machine.

The disk that comes with 64 CP/M contains the CP/M operating system, plus some utility programs that let you do things like copy files and format disks. When you run CP/M, all you really have is an alternate DOS. It does nothing on its own, unless you're merely interested in programming the Z80 on your own. The missing link is CP/M software.

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design. At first glance, one is reminded of an IBM-PC. It's a smart-looking, sleek machine with an off-white color. The keyboard has been thoughtfully designed, especially for those upgrading from a 64. With the exception of the function keys, the 64's keyboard is intact (see photo). But there's a lot more. A numeric keypad is included to the right of the main character keys. A top row, from left to right, includes ESCAPE, TAB, ALTernate, CAPS LOCK, HELP (similar in function to the help key of the Plus/4), LINE FEED, 40/80 DISPLAY, and NO SCROLL. Continuing on that row are four cursor keys, providing an alternative for those who never liked or got used to those on the 64, and four function keys, identical to those on the 64.

The 128 might be seen as an entry into the lower end of the business market currently dominated by the IBM-PC and its compatibles. While this is arguable, the fact that it seriously upgrades the power and flexibility of home computing is not. A huge array of CP/M-based software exists, although the PC market has moved away from CP/M in favor of MS-DOS (see "What Is CP/M?" for more on this). A plus for the new machine is its support of true 80 columns with RGB output. Unfortunately, Commodore owners with composite monitors, such as the 1701, 1702, or 1703, will have to upgrade to an RGB monitor to use the 80-columns of the 128. While the technology of the 128 is not new, Commodore is offering a solid product at a very affordable price.

Where's The Software?

Thousands of good programs were written for CP/M and are still in use today. CP/M users and user groups created a vast amount of public-domain software. Most of this software would run under 64 CP/M, if you could get it into memory. But the 1541 disk drive can't read a CP/M disk. More 1541-readable software is necessary for CP/M to have any value at all. A large New York user group has been busy transferring public-domain software to 1541 format (see the "Horizons" column in the October 1984 GAZETTE for more information), but the amount of usable CP/M software is still dismally small. Commodore, at the time of this writing, has two programming languages you can run under CP/M: Nevada Cobol and Nevada Fortran. Soon, Commodore will release a set of business tools, the Perfect software series (see the CES feature story for more on this).

The new 1571 disk drive helps solve the problem. CP/M for the Commodore 128 reprograms the disk drive so that it can directly read disks created on other disk drives.

Why bother with CP/M at all? There are many good CP/M word processors, but there are several word processors for the 64 that are every bit as good. There's much more business software available to CP/M machines, but most home computerists won't really want to run an Accounts Receivable program. When the 64 was first introduced, CP/M looked like an excellent way to get around the paucity of available software, but there's now almost too many 64 programs to choose from.

A Business Bargain

However, CP/M may make the Commodore 128 a bargain buy for small businesses. The price of the Commodore 128 with the 1571 disk drive is competitive with the IBM PCjr. CP/M software has been around long enough to be time-tested and bug-free. There's so much CP/M software that there's a good chance you'll find special-interest programs—programs that wouldn't have mass appeal, but could be just what you're looking for. For example, some programs are customized for particular businesses, such as a bookkeeping system designed especially for a dental practice.

CP/M promises a cornucopia of software. Some of this software may be useful to you, although most of it probably won't. It remains to be seen though, with all the technological advances we're now seeing in hardware and software, if anyone really wants to run five-year old software.

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In support of the 128, Commodore also has a new line of peripherals: the 1571 Disk Drive, the 1901 Monochrome Monitor, the 1902 RGBI/Composite Monitor, and the Commodore Mouse. Although prices have not yet been set on any of these new products, they should be available at about the same time as the 128. The 1571 drive is double-sided (360K storage per disk) and far more intelligent than the 1541. Although it's serial and reads at the same speed as the 1541 in 64 mode, it's five times faster when used in 128 mode and almost 12 times faster in CP/M mode. Most CP/M software, regardless of format, can be used with the 1571. The drive is also compatible with the 64, Plus/4, and LCD.

The 1901 is a green screen 80-column monitor designed for business and productivity applications such as word processing, data base management, and spreadsheets. The 1902, ideally suited for the 128, contains a front video switch for composite or RGB display. In 64 mode, composite (40 × 25 columns) would be selected, thus emulating the display of the 1700 monitor series, and in 128 or CP/M mode, either composite or RGB (80 × 25 columns) is available.

The Commodore Mouse, functionally identical to Apple's mouse, provides an alternative to a joystick. No price and few details were announced, but it should be available for the 128 later this spring.

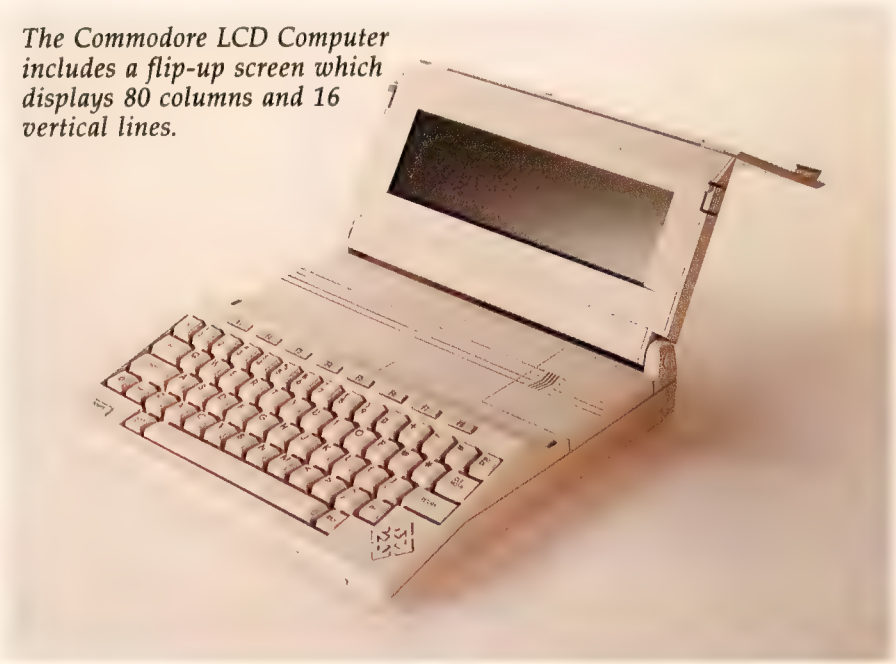
Commodore also announced the 1670 Modem, a 300/1200 baud modem which features auto answer/auto-dial, auto baud, and parity. (Auto baud determines the baud rate of another computer and automatically adjusts the rate of data transmission.) It's compatible with the 64, Plus/4, and 128. Although we didn't see the 1670 at the show, it should be available this spring. It may be priced at less than $100, a real bargain for a 1200-baud modem.

Among the new Commodore peripherals are the Mouse, MPS 802 Printer, 1902 RGBI/Composite Monitor, and the 1571 Disk Drive.

Commodore's second major entry, the LCD, is a portable lap computer, with built-in software, modem, and flip-up screen. Commodore was showing only prototypes of this machine, so it was difficult to assess the software (word processor, file manager, spreadsheet, address book, scheduler, calculator, and memo pad), some of which was incomplete. However, we did note that the LCD screen is exceptionally fast, and the 80 × 16 column display is highly readable. The machine runs on four AA alkaline batteries or external power, and is easily transportable, weighing about three pounds.

The microprocessor used in the LCD is the 65C102, a modified and faster version of the 6502. Importantly, Commodore has included several I/O ports: RS-232, Centronics parallel, barcode, standard Commodore serial, and the 300-baud, auto

The Commodore LCD Computer includes a flip-up screen which displays 80 columns and 16 vertical lines.



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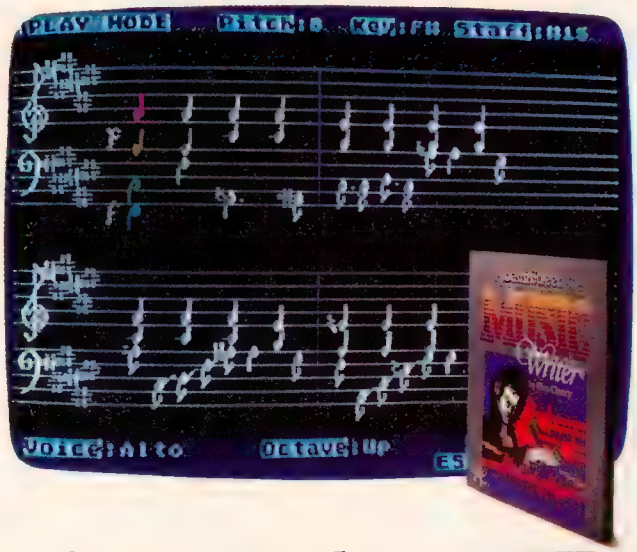

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answer/auto-dial modem. The LCD is programmable (BASIC 3.6 is included), and it stores files permanently. If peripheral file storage is appropriate, the LCD is compatible with the 1571 and 1541 disk drives. Curiously, Commodore was showing Sony-standard 3-1/2" serial disk drives in use with the LCD, but little information was available on these obviously raw prototypes.

If Commodore delivers the LCD for under $600, it should have a very strong competitive edge in the "notebook" computer market.

Several other important announcements were made at Commodore's CES press conference. One of the most heartening, for Commodore owners, was the establishment of a national service network which includes 160 RCA service centers, about 800 Sears stores, and nearly 1300 other outlets which include computer stores. Computers and peripherals in or beyond warranty can be serviced at these locations beginning in March.

Although a lot of software for the 64 was announced by third party companies (see "CES Perspective: Much More For The 64"), Commodore introduced only two new packages, both for the 128. *Jane*, developed by the Arktronics Corporation, is icon-based productivity software featuring an integrated word processor, spreadsheet, and filing system. It's designed for use with a joystick or the Commodore Mouse. Reminiscent of Macintosh software, *Jane* uses pop-up menus and windows. For 80-column CP/M mode on the 128, Commodore announced the Perfect Series, produced by Thorn EMI. This integrated software line, which includes *Perfect Writer*, *Perfect Calc*, and *Perfect Filer*, has been on the market in MS-DOS format for the IBM-PC and compatibles for some time. No prices were announced for *Jane* or the Perfect Series.

While Commodore has an impressive array of new hardware, Atari has the jump on offering a new technology to the low-end market. Jack Tramiel and dozens of ex-Commodorians (collectively self-identified as the "New Atari"—although others may prefer the "Old Commodore") unveiled six new computers, seven printers, three disk drives, and four monitors.

Atari's new computers represent two new series, the XE line (four machines upwardly compatible with the Atari 800 and 800 XL), and the real showstoppers, the 130ST and the 520ST. The ST machines, driven by the 16/32 bit Motorola 68000 microprocessor, the same chip found in the Macintosh, can basically be understood as color Macintoshes with a choice of input devices (keyboard, joystick, or mouse) and several more features. For $599, the 520ST offers 512K RAM, a built-in hard disk interface (for $399 you can get an extra 15 *megabyte* hard disk for storage, the equivalent of about 90 Commodore 1541 disks), three screen graphics modes (640 × 400 pixels in hi-res), a three-voice sound generator with a MIDI interface for communication with external electronic instruments such as synthesizers, and a GEM operating system, which controls graphics features such as icons, windows, and drop-down menus.

The 130ST is a 128K version of the same machine and is priced at $399. The XE series includes the 65XE, a 64K enhanced version of the 800XL, to sell for $99; the 130XE, a 128K version for under $200; the 65XEP, a transportable version of the 65XE which includes a built-in monochrome monitor, 3½-inch disk drive, and battery pack, to sell for under $400; and the 65XEM, essentially a 65XE with an eight-voice AMY sound chip that includes 64 oscillators. Reportedly, the AMY chip can be programmed to simulate *any* musical instrument. This machine will be offered for under $200.

The support peripherals for all of Atari's new machines are also priced very low in keeping with Jack Tramiel's marketing philosophy. Release date for Atari's new hardware is April or May. (For more details on Atari's new products, see the CES report in April COMPUTE!).

With Atari and Commodore as the two remaining gladiators in the low-end arena, 1985 will prove to be an interesting year. Both Commodore and Jack Tramiel are notorious for underselling the competition, and the new hardware prices, while surprisingly low, are not really unexpected. But, while both companies are claiming Apple and IBM as targets, they're also aiming at each other. One source told us that the Atari ST is really Commodore's Amiga (also with a 68000 microprocessor), that some of the engineers brought to Atari from Commodore by Jack Tramiel knew the Amiga well enough to produce a replica. But Commodore denies this, hinting that the Amiga is more powerful and different than the ST. All intrigue aside, we'll see the Amiga in the market later this year. (For details on the Amiga, see "The Editor's Notes" in the November 1984 GAZETTE.)

We're sure to see more from Commodore and Atari at the Summer CES in June, and possibly even before then. But their announcements at this CES are significant if only for one reason: much more power at much lower cost.

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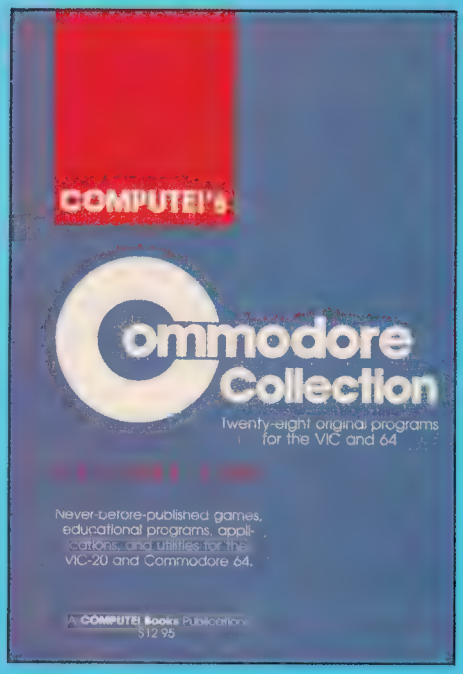
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CES Perspective:

Much More For The 64

Kathy Yakal, Feature Writer

Christopher Cerf had some explaining to do when he bought a home computer a few years ago. Cerf, a longtime author and designer of children's educational tools, was told by a friend that he would no longer be a good writer. "You shouldn't be using a word processor," said his friend. "Everyone knows that the only time you have a good idea is when you're pushing the manual carriage returns on an old Royal typewriter."

In spite of the computer industry's progress in recent years, that kind of attitude still prevails among a number of people. Fear of the unknown, and the inevitable failure of myriad hardware and software companies and trade publications, have given the public (and the press) countless opportunities to predict extinction.

If last January's Consumer Electronics Show was the beginning of the end, it didn't look like it. This was to be the CES, said many industry observers, where everyone would be holding his breath.

It appears, rather, that it was just the end of the beginning. True, the ranks continued to thin out. But the strong showing by Commodore and Atari, as well as the promise of healthy third-party support for both companies, were encouraging. The next generation of home computers is well on the way.

"We're just at the beginning of the industry," says Jim Levy, president of Activision. "The doomsayers are saying it's not what they thought. Well, it is what it is. What it is, is very young. There are still only a few million real computers, and state-of-the-art in software is still primitive.

"We can't look for an overnight explosion, but it's not going backwards either. The computer is too fundamental a consumer product revolution not to happen. Over the next few years, there will be nice, steady growth. And it will still be one of the fastest growing consumer industries."

Though some very promising software appeared at CES, the main excitement on the floor was over hardware. Young employees of the new Atari Corporation, uniformly dressed in gray slacks and maroon sweaters, stood next to their new machines for hours, tirelessly answering questions. Prototypes of the new Commodore computers revolved in a showcase window as crowds constantly pushed through the booth for a closer look.

Besides the new computers, many new peripherals for Commodore were introduced by third party companies. At least four Commodore-compatible disk drives were shown, from Cardco, Indus, MSD, and Blue Chip Electronics.

Printers are getting even cheaper, faster, and more powerful. Okidata introduced the Okimate 120, a dot-matrix, 120 cps printer. Unlike its sister, the Okimate 10, it does not print color. It uses a cartridge ribbon for longer wear. Price is expected to be under $300.

Star Micronics, manufacturer of the popular Gemini-10X, premiered a new line of dot-matrix printers, including the SG-10, an enhanced 10X priced at $299. It runs 20 percent faster, has a near-letter-quality (NLQ) mode, and a larger buffer. Prices in the new SG, SD, and SR printer lines range from $299 to $799.

At least two companies showed new music keyboards for the Commodore 64. The *Music Port*, by Tech Sketch, features a full-size electronic keyboard with true digital synthesizer capability. With software, it has a suggested retail price of $149. Sequential Circuits announced the *MusicMate*, a full-size keyboard priced at $99 with the starter software package (expansion software is available for $39.95).

Activision was one of dozens of companies at the show introducing new entertainment and home productivity software for the 64. New programs include *The Music Studio*, a music composition and audio synthesis package; *Web Dimension*, a rich sound-and-graphics

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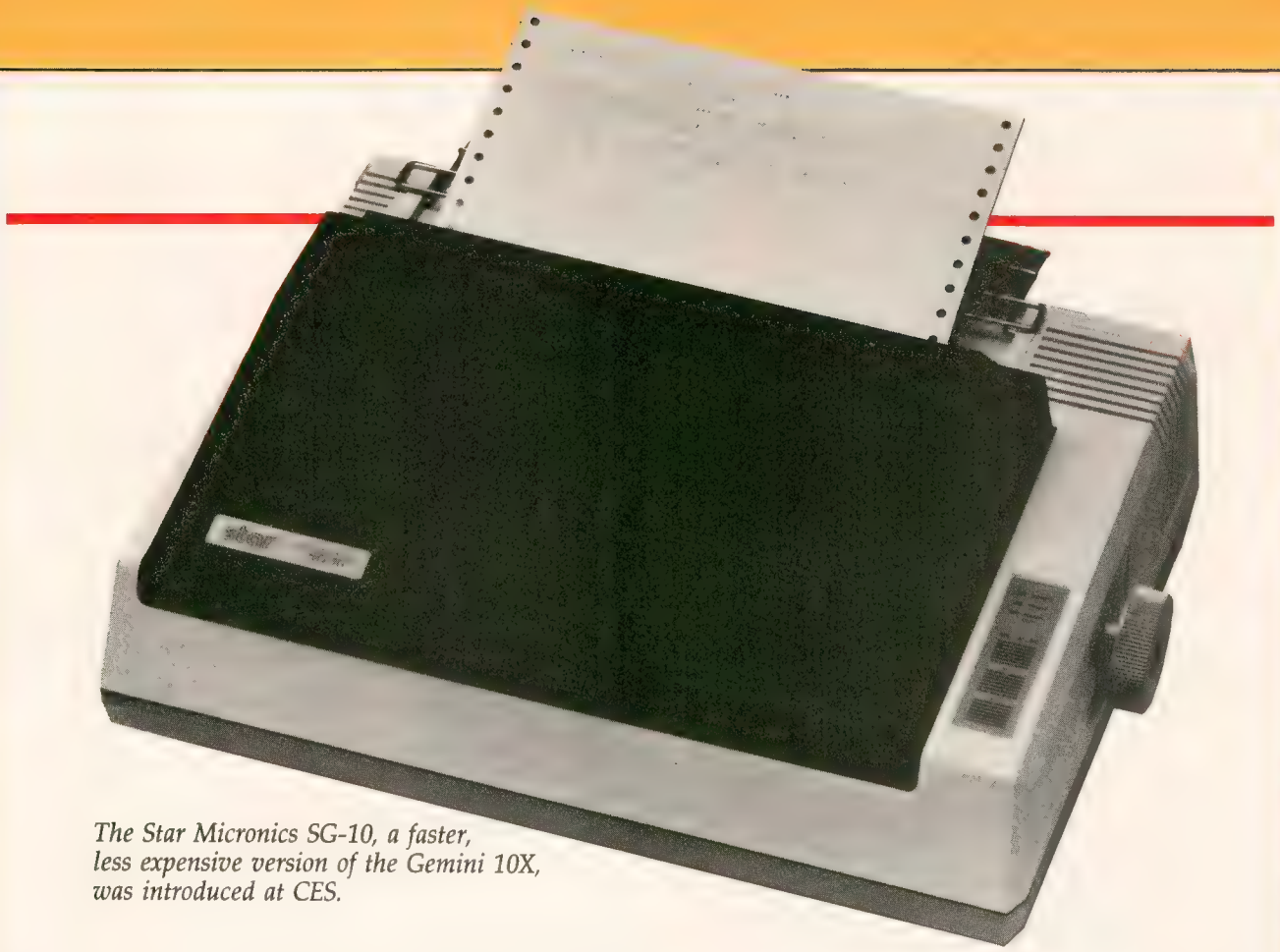

The Star Micronics SG-10, a faster, less expensive version of the Gemini 10X, was introduced at CES.

trip through the evolutionary stages of man ("from atoms to astronauts"); and *Rock 'n Bolt*, a humorous strategy/action game.

Sneak previews of summer releases were also on display: *Countdown To Shutdown*, a futuristic action/adventure game involving a team of robot commandos which must prevent a reactor shutdown; *Alcazar: The Forgotten Fortress*, a fantasy/adventure set in a Spanish countryside; *The Great American Road Race*, a cross-country trek; and *Fireworks*, a fireworks display construction set.

Levy and his staff try to determine what will please their home computer audience the same way a film studio decides on projects, or a soap company tests different scents and sizes. "Consumers are looking for what they've always looked for," says Levy. "Two things. The things he has to do in his life—he wants them to be easier, quicker, and more interesting. The second is good things to goof off with. We all live that way. We eat and sleep, and the rest of the time we either work or play. So it's important to recognize that the computer has two fundamental functions from a software standpoint: things that you have to do that the computer can help you do easier, faster, and better; and creative use of goof-off time."

Creative, *inexpensive* use of goof-off time was offered at the show by Mastertronic, a British software firm that has recently begun U.S. distribution. "Sales of game software did not reach projections for the past year, mainly because of price," says Mastertronic's Dave Harding. "Mastertronic Ltd. did something about this, first in England (where it has sold more than two million pieces since April), and then in Canada. We will do the same here."

The initial ten titles, priced at $9.99, include arcade games (*Chiller; 1985–The Day After; Dark Star; More Adventures Of Big Mac, The Mad Maintenance Man*) and one adventure game, *Monty Python's The Quest For The Holy Grail*. Ten additional programs will be released by mid-1985: arcade games, strategy games, and the firm's first four educational programs. Also a part of this group will be *The Games Creator* ($19.99), an arcade game construction set which lets nonprogrammers create or alter every aspect of game play.

"You Can't Kid A Kid" was software publisher Epyx' theme, and kids ran the show at their booth. Several 8 to 15 year olds demonstrated Epyx' line of entertainment software, including 13 new titles. *Ballblazer*, developed by Lucasfilm Games, is a futuristic two-player fantasy game using a split screen and distinctive

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Until Mitey Mo, Commodore's 1650 Automodem was the obvious choice when you went looking for a modem for the C-64. Like Mitey Mo, it has "auto-answer"— it receives data while unattended. And both modems are "auto dialers"—you dial right on the computer's keyboard. But that's about where their similarity ends.

Suppose you dial a number,

MODEM FEATURES	MITEY MO	COMMODORE AUTOMODEM
Auto Dial	YES	YES
Auto Answer	YES	YES
Auto Redial	YES	NO
Smart 64 Software Included	YES	NO
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VT-52/VT-100 Emulation	YES	NO
Menu Driven	YES	NO
28K Software Buffer	YES	NO
Printing Capability	YES	NO
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Bell 103 Compatible	YES	YES
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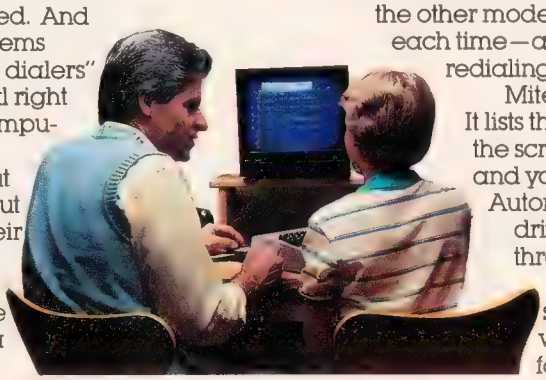

and you find that it's busy. Mitey Mo has "auto redial"—it hangs up and redials immediately until it gets through. With the other modem you have to redial each time—and somebody with auto redialing can slip in ahead of you.

Mitey Mo is menu-driven. It lists the things you can do on the screen. Select a number and you're on your way. Since Automodem isn't menu-driven, you'll be hunting through the manual a lot.

Mitey Mo has only one switch, the customized software does the rest. Every family member will find it easy to use. With the other modem you'll have to remember to check three switches, otherwise you may be answering when you mean to be originating.

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three-dimensional graphics. *Rescue On Fractulus* is a space action/strategy game featuring 3-D flight simulation also developed by Lucasfilm. *Summer Games II*, sequel to the successful *Summer Games*, and *The Right Stuff*, a flight simulation game set during the Battle Of Britain in World War II, were also introduced.

Synapse Software initiated its Electronic Novel series, a new line of interactive adventure games/novels. The Electronic Novels are written by an author-programmer team, using a proprietary language developed by Synapse. The first titles in the series are *Mindwheel*, a journey into the minds of four deceased people of extraordinary power (written by Robert Pinsky), and *Essex*, the story of an intergalactic search and rescue mission.

Professional Software rolled out the second volume of its popular *Trivia Fever*, as well as a special sports edition. *Trivia Fever, Volume 2* retails for $24.95, *Super Sports* for $29.95.

The Music Shop, one of Brøderbund's new releases, is both a music composition tool and music synthesizer. It offers a Macintosh-like environment for ease of use and will sell for $44.95.

Creative Software has added to its line of entertainment and personal productivity software for the Commodore 64 with *Trolls And Tribulations*, a strategy/action game in which the player leads his six trolls through treacherous underground caverns to recover hidden treasures. It retails for $24.95.

Shakespeare and sports are the themes of Imagic's new software offerings. In *Macbeth*, from Imagic's Time Traveler series, you return to eleventh century England to find out if the character Macbeth was a murderer and tyrant or a hero tricked into self-destruction. The Action Sports series includes *Tournament Tennis*, *Grand Slam Baseball*, and *Touchdown Football*.

Strategic Simulations, Inc., long recognized for excellence in strategy and war games, introduced *Kampfgruffe*, SSI's answer to the advanced wargamers search for a technical level warfare game on the eastern front during World War II. It retails for $59.95.

CalKit is Batteries Included's latest entry in the home productivity market. It's a flexible home finance and math package designed like a simplified spreadsheet. (Batteries Included also has a new interface that links the Commodore 64 to printers from all the major manufacturers.)

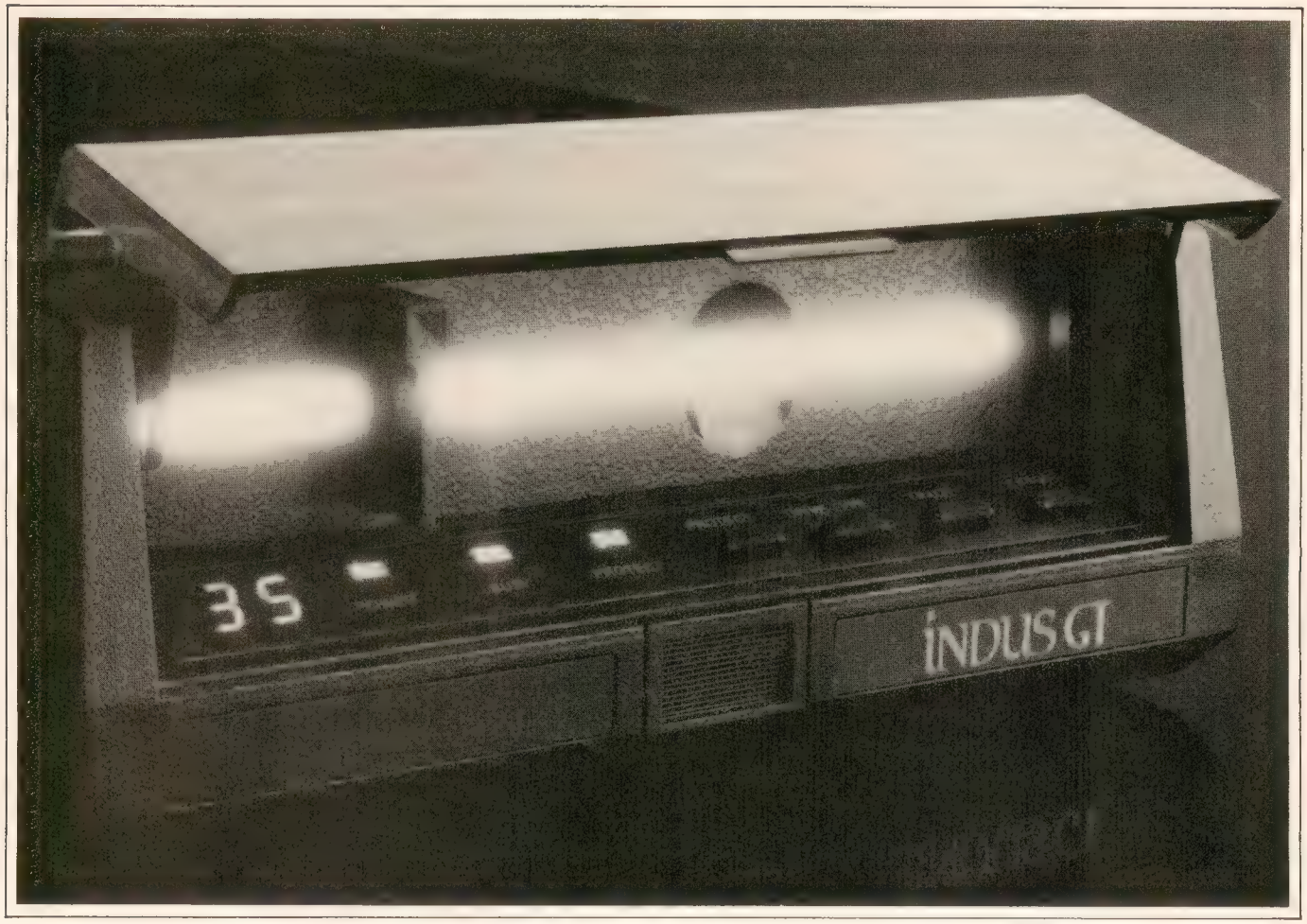
Mindscape president Roger Buoy had been offered four different software companies by the third morning of CES. A bad sign for the educational software industry? Not at all, he says.

"People make all this noise about the shakeout, but it's really a lot of nonsense," says Buoy. "What's going on in this business is no different from what's going on in other businesses. You always have companies that are not properly funded and not properly managed that fall by the wayside. That's not an abnormal phenomenon. It happens in every new business. But this one is highly visible, and it has a lot of pop culture in it."

Buoy recalls a CES three years ago when there were three or four educational software publishers exhibiting. Two years later, he says, there were 79. "The market has grown tremendously, but when you're trying to share it with 79, the personal shares become less."

Mindscape showed two new programs in its Sprout line, educational software developed by children's author Mercer Mayer: *Castle Clobber* and *Subtraction Fair* ($24.95). *Bank Street Storybook*, by George Brackett, and *Bank Street MusicWriter*, by Glen Clancy, were both being demonstrated by their authors. Software

Software developers Christopher Cerf and Joyce Hakansson teamed up to produce Kermit's Electronic Storymaker, *one of a series of programs being marketed under the banner of the Muppet Institute of Technology and published by Simon & Schuster's Electronic Publishing Group. The programs are designed to stimulate reading and writing skills, and to encourage imagination.*



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Sequential Circuits MusicMate, a $99 musical keyboard for the Commodore 64.

developer Tom Snyder was also on hand to show people around the universe with his new project for Mindscape, *The Halley Project: A Mission In Our Solar System*, a real-time simulation of the solar system. And *ColorMe: The Computer Coloring Kit*, lets young children design their own pictures, coloring books, and stickers, then print them out.

Like Mindscape, a subsidiary of SFN Companies (a large textbook publisher), CBS Software has major financial backing. "It's comforting not to have to answer to bankers and investors," says president Ed Auer. "The CBS vision goes far beyond the last quarter of '84 or the first quarter of '85. We're in it for the duration."

CBS introduced 12 new programs at CES, expanding their line to a total of 58. *Success With Algebra* includes four classroom-tested algebra tutorials for grades 7–12. *The Sea Voyagers* is an electronic learning game which chronicles the lives and discoveries of 30 New World explorers. Children's TV show host Fred Rogers was involved in the development of *Many Ways To Say I Love You*, a design tool that allows children to create their own electronic greeting cards. In *The Railroad Works*, you can plan and build railroad empires.

Auer is not nervous about the state of the industry. "We never did believe the predictions of a few years ago, that 40 percent of homes would have computers by 1987. By the 90s, that's entirely feasible. We're very comfortable that it's going to be a significant industry."

Perhaps those people who weren't holding their breath at last winter's CES were catching theirs. "We have the opportunity to manage our businesses better now that things aren't moving so rapidly," says Activision's Levy.

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Douglas Adams and Steve Meretzky

Designers Behind *The Hitchhiker's Guide To The Galaxy*

Sharon Darling, Research Assistant

Take two minds that have created some very witty books and computer games, put them together, and what do you get? The zany game version of *The Hitchhiker's Guide to the Galaxy.*

The happy result of those two very different backgrounds is a microcomputer game version of the popular *Hitchhiker's Guide to the Galaxy.*

It took six years for Adams' original idea of a story about a guide to the universe—similar in nature to those books on how to travel the continent using one's thumb—to come to fruition. However, that idea, launched while Adams was hitchhiking through Europe, quickly snowballed from a simple concept into a long-lasting fad which has put such phrases as "don't panic" and "don't forget your towel" into the vocabulary of millions of people, first in England, and then in the United States.

The first volume quickly led to three other books: *The Restaurant at the End of the Universe; Life, the Universe and Everything;* and *So Long, and Thanks for All the Fish.*

Imagine yourself as hapless Arthur Dent, a mild-mannered Englishman who is quite fond of ale from the local pub. Upon groggily waking up one morning with a terrific headache from too much beer at that same pub, you discover that your house is scheduled to be demolished in order to make room for a new highway.

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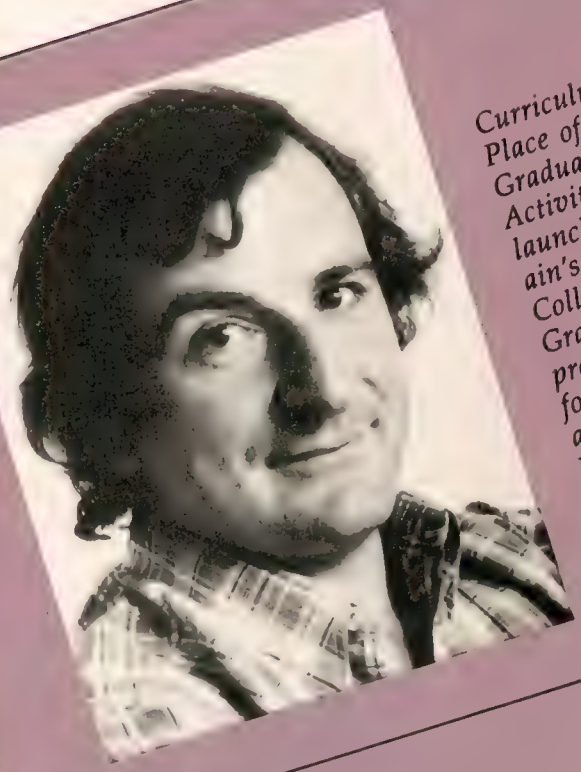
From there you begin a journey through the universe, accompanied by your friend Ford Prefect, a professed actor who is really a roving researcher for the *Guide* (a sort of computerized radio that's hooked into a encyclopedic database, very useful for hitchhikers). In reality, he's also an alien who hails from near the star Betelgeuse. Prefect's mission on Earth: To come up with a more detailed description of the planet than the two words contained in the *Guide*'s current issue: "mostly harmless."

Since the game doesn't hinge on the action in the book, players don't need to have read *Hitchhiker's Guide* in order to play it, Meretzky says. "If you've read the book, it will probably make the first part of the game a bit easier for you, but that's about it," he adds.

But both Adams and Meretzky worked long and hard



Curriculum Vitae, Douglas Adams
Place of birth: England
Graduate, Cambridge University.
Activities: Footlights Club, launching pad for many of Britain's great comics. Work history: Collaborated with Monty Python's Graham Chapman on several projects; writer and script editor for the TV series Dr. Who; creator of BBC radio serial, The Hitchhiker's Guide to the Galaxy, which spawned four books, a television series, two records, a stage show, and a soon-to-be-filmed movie.

Curriculum Vitae, Steven Meretzky
Place of birth: United States
Graduate, Massachusetts Institute of Technology (MIT), breeding ground for many of Infocom's computer game designers. Work history: Before realizing his calling as a computer game designer, worked in construction project management; started playtesting games for Infocom in his spare time. Eventually moved up to writing games.
Game writing credits: Planetfall *and* The Sorceror.

to make sure the game was faithful to the book, while at the same time turning it into a new adventure. What they did weave into the fabric of the game were detailed explanations of events that are mentioned only briefly in the book.

"In some ways it's easier, and in some ways, it's harder" to write a game from a book, versus using an original concept, says Meretzky. "It's easier because you have some constraints on the universe you're going to be designing, and on the characters you're going to be using . . . and you don't have to come up with as many ideas.

"On the other hand, there's more of a challenge because you want to take advantage of the features of an interactive game, and you don't want it to be just a translation of the book, because the book is necessarily linear. If it was just a translation," he adds, "there wouldn't be any reason to do it at all. You have to avoid getting into the trap of 'well, this is the way it was in the book, so this is the way it has to be in the game.' "

An Open Letter To The User Community

SPA

Software Publishers Association

Dear User Group President and Bulletin Board Sysop:

Although the microcomputer software industry receives ample coverage by the media, the focus is generally on software and hardware developers and vendors. We frequently forget that there is another group of heroes that gets insufficient credit for promoting the growth of our unique industry. The Software Publishers Association, the trade association of over one hundred publishers of microcomputer software, salutes you, the user group president and bulletin board sysop, as an unsung hero. Space prohibits us from detailing the extent of your contribution to the growth of the microcomputer industry. Suffice it to say, however, that without the growth of hundreds of user groups and electronic bulletin boards, the industry would not be where it is today.

Just as user groups and electronic bulletin boards have promoted the growth of the industry, these same groups hold the key to the solution of one of the most difficult problems now facing the software industry—the unauthorized duplication and distribution of microcomputer software. The problem is not new. What is new, however, is the extent of the lawlessness involved. The law is clear. It is a violation of U.S. Copyright Law to reproduce software (except for purely personal archive purposes) without authorization. The penalties are also clear. Violators are subject to fines of up to $50,000 and prison terms of up to five years. Since the violation of the copyright laws is a federal offense, the FBI has become increasingly involved in enforcing the law. The software industry has sought to deal with this problem in several ways. One has been an "arms race" of copy-protection systems. Another has been litigation against offending companies, user groups, and bulletin board operators.

There must be a better way for the software industry and the user group community to work together to protect everyone's rights. We seek a dialogue with leaders of user groups and bulletin board sysops. Let's hear from you.
Please direct your comments to:

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Software Publishers Association
Suite 1200
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Washington, D.C. 20036

Sincerely,

Kenneth A. Wasch

Kenneth A. Wasch
Executive Director

About the Software Publishers Association

Formed in April 1984 by leading publishers of microcomputer software, the SPA has grown to include more than 100 firms, representing all of the major segments of the microcomputer software industry: business, home, entertainment, and education. The members of the SPA recognize that the future health and growth of the microcomputer industry depends on establishing a partnership among all segments of that industry, including the most important segment—the computer user.

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Tackling computer games was a new experience for Adams, even though he has Ford Prefect referring to the *Guide* as an electronic book, a familiar computer term today, but a new concept in 1977. "As far as I was concerned, it was completely imaginary," Adams says. "I didn't even become computer literate until about a year ago, whereupon it suddenly sort of swept over me like a tidal wave."

Author, humorist, and composer Christopher Cerf brought Adams and Infocom together. "I'd seen Infocom's games in detail, and one or two other adventure games briefly," Adams says. "I'd not been interested, but Infocom's were obviously a great deal better than the others—they'd been written with style, wit, and intelligence, and I just felt that here were guys on the same wavelength."

Adams' ideas about adapting a creative work in print form to video perhaps explains how *Hitchhiker's Guide* has maintained its integrity and style in all its various permutations. "Rather than just picking up a book and entering it into the computer, you have to go all the way back to the very jumble of ideas about what might be in it, just a sort of feeling about it.

"Then, you get interested in the medium, and explore that medium with some of those ideas in mind, rather than doing just straight text. The nice thing about *Hitchhikers*," he adds, "is it's not a concrete story, it's not particularly firm in any one medium—it's just a set of approaches and attitudes, with a few rough ideas about some characters."

That fluidity meant that there were several points in the book's story line where Adams and Meretzky could let their imaginations loose to create new situations for the game version. One thing that remained intact, though, was the humor inherent in the book.

"A lot of the same humor is explicitly there, just in the text of the game," Meretzky says. "Also, a lot of humor is created just by using the style of the game." For example, one command common to all Infocom games is "inventory," where you find out everything you are carrying at any particular moment. At the start of *Hitchhiker*, you are told that Arthur Dent's inventory consists of a) no tea, and b) a splitting headache.

One convention carried over from the book was footnotes, which are sprinkled throughout Adams' novel. "I thought there must be some way to incorporate [those] into the game," Meretzky recalls. "So what happens is, at various points in the text of the game, you'll see a reference to a footnote, and simply as your turn, you type in footnote 12, or whatever, and you get the text."

While some of the footnotes are straightforward, they can be amusing, such as one referencing a ray gun that never seems to work properly. "It's not a very good ray gun, is it?" the game responds to that footnote. "There's a lot of that, kind of taking a step back from the game and laughing at it from the outside," Meretzky says.

Putting British humor into perspective for an American audience never posed a problem, Adams says. "I tend to feel the difference between English and American humor is much more apparent than real. I've never had the slightest problem in enjoying American humor. Everyone told me I was going to have immense difficulty in getting American audiences to respond to *Hitchhiker*, which has absolutely not been the case."

The book's humor has succeeded on both shores of the Atlantic perhaps because Adams didn't have any particular audience in mind, besides himself, when he wrote it in 1977. "Targeting something toward a particular audience, that's not something writers do, that's something that marketing or advertising people do," Adams feels. "I'm not selling toothpaste, I'm making ideas."

The process of translating those ideas from a novel to a computer game took about eight months, with Meretzky and Adams first meeting for about a week in Boston to map out the game's general direction. Then, Adams returned to England, and the two corresponded daily through electronic mail.

"When we had got a lot of it sitting there waiting to make sense, and not apparently being about to do that, Steve came over to England, and we hammered out answers to make it look as if the way it ended was what we'd intended all along," Adams recalls.

During the writing process, Meretzky says he tried to closely emulate Adams' style. Apparently, he succeeded, as Adams commented once that he couldn't tell whether he or Meretzky had written certain parts of the text.

As your game's journey continues, your survival depends on a very motley crew. Playing Arthur Dent, you've survived Earth's destruction by hitching a ride on a passing spaceship, but you're not sure that was really as lucky an occurrence as it first seemed. For now, your fate rests with two-

headed Zaphod Beeblebrox, president of the Imperial Galactic Government; his girlfriend, Trillian, whom you realize is the same girl you tried to pick up at a party recently; Ford Prefect; and Marvin, a paranoid android. Good luck.

Meretzky says one of the main reasons he was chosen to work with Adams was because of his previous work with comedic science fiction in *Planetfall*, an award-winning game. He was also a *Hitchhiker* fan, as were most of the folks at Infocom.

The two started out their collaboration by following the plot of the book closely. Then, "I guess he (Adams) got used to the idea of writing interactively, and the more I got used to the idea of giving him ideas and of working with him, the more the ideas started to flow," Meretzky says. "By the end, we had way more ideas than we were able to use."

All those extra ideas that never made it into the game are "definitely" enough for a sequel, Meretzky adds. However, don't necessarily look for a fifth book in the *Hitchhiker* saga, Adams says. He claims the recently released fourth novel is the "final, final, final one. There is definitely, definitely, definitely not another one after this—at least not for a while."

But don't panic. Audiences both here and abroad have not heard the last from Adams. After filming is completed on the movie version of *Hitchhiker's Guide*, he says his next project will probably be a screenplay. A novel based on that movie will be written afterward, he says.

And Meretzky also has more games up his sleeve. While he's got some science fiction game ideas in mind, he's also contemplating a mystery game, which would be a new area for him.

Until then, enjoy your journey through the galaxy. And don't forget your towel.

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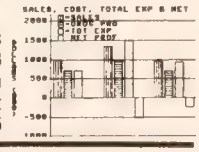

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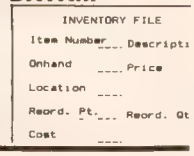

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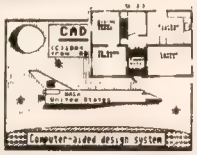

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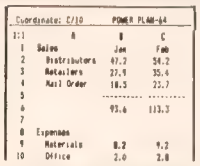

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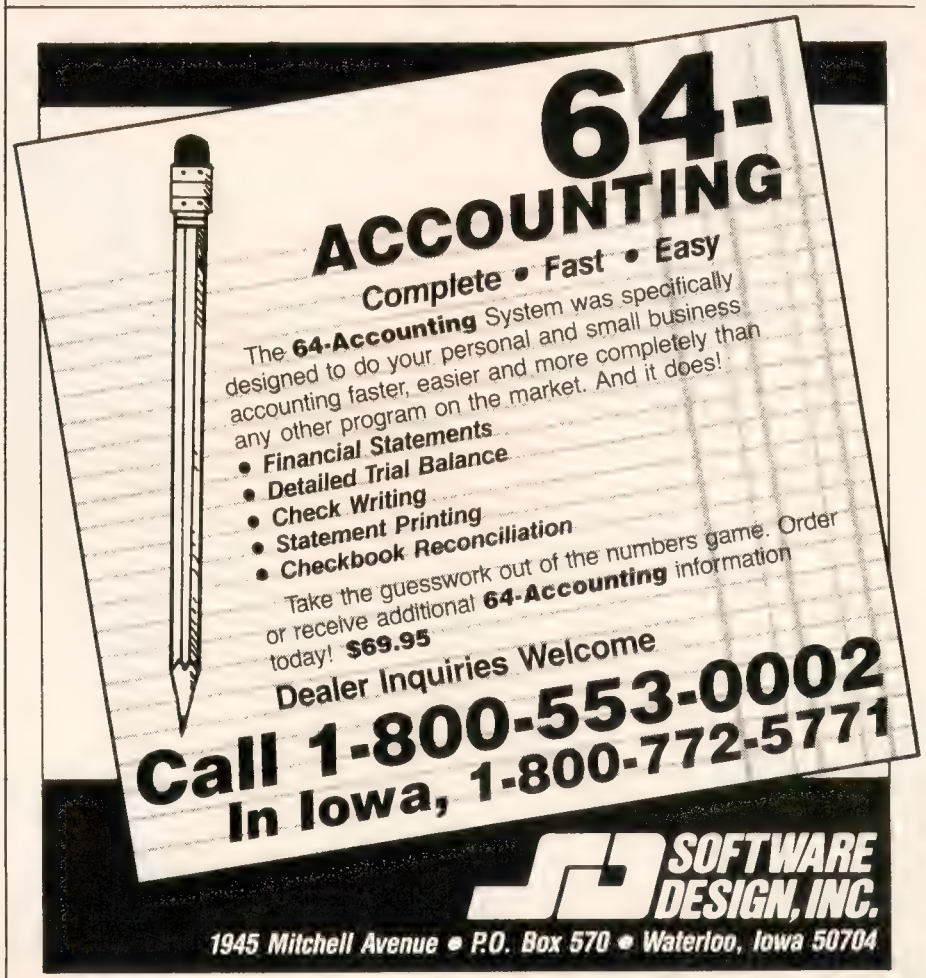
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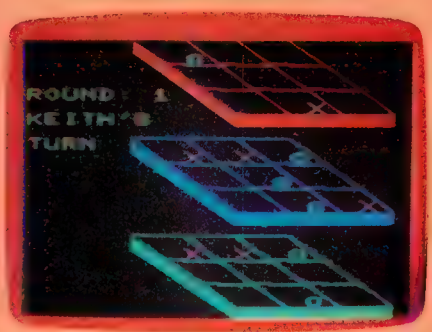

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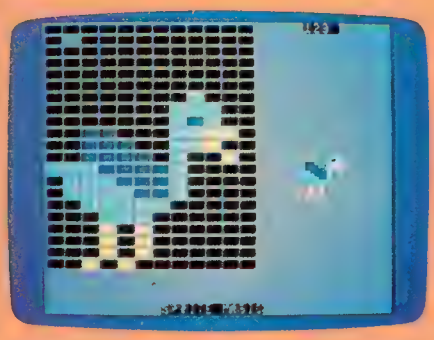

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353D02

Pool

Joseph T. Woyton

Chalk up your cue stick and sharpen your skills with this exciting simulation of pocket billiards. For one or two players. Originally written for the unexpanded VIC, we've added a version for the 64.

The rules of "Pool" are simple—you try to sink the billiard balls on the table by aiming and shooting the white cue ball.

The VIC version accepts either keyboard or joystick input (for details on how to play 64 Pool, see the programmer's notes accompanying this article). Use the joystick (or f3 key) to rotate the cue stick around the cue ball. Shoot it by pressing and *holding* the fire button (or f1). The longer you hold it down, the softer the shot. For a hard shot, release the button or key immediately.

Your turn continues as long as you keep pocketing balls. If you miss or scratch, your opponent takes over (if you're playing solo, try playing left against right hand). After a scratch, the cue ball may be positioned anywhere behind the scratch line using the joystick (or f3 and f5). Once you've selected a spot, tap the fire button (or f1) and continue playing.

The 15 balls are randomly placed after the last ball is sunk. You can then continue the game (up to a mutually agreeable limit) or respond to the prompt for a new game.

VIC Program Description

The main play routine of the program makes the billiard balls move, carom, and collide. In this routine, motion is simulated by POKEing a ball character to the next screen position in the direction of travel, and then POKEing a blank space to the previous position, erasing it. The resolution of the VIC's screen permits only eight directions of movement.

The program PEEKs ahead for upcoming collisions. When the edge of the table is reached, the direction of travel is reversed. When pockets (CHR$(102)) are detected, the scoring subroutine is called.

The ball slows down as it travels by using progressively longer time delays between screen POKEs. Sound effects punctuate ball impact, scoring, and turnovers. The REMark statements should help you follow the flow of the program.

VIC Program Variables

A	=	**character under cue stick**
B	=	**current ball character**
B0	=	**cue ball, CHR$(87)**
B1	=	**object ball, CHR$(81)**
C	=	**player code; +1 for player A, −1 for player B**
D	=	**ball velocity time delay**
H	=	**1 for hit pocket, 0 for no score**
I	=	**ball direction increment**
J	=	**joystick input**
K	=	**keyboard input**
P	=	**ball placement during table setup**
Q	=	**current ball location**
Q0	=	**cue ball scratch location**
QC	=	**cue ball play location**
SA	=	**player A score**
SB	=	**player B score**
T	=	**sound effect time delay**
V	=	**cue stick or cue ball vector**
Z	=	**cue stick character**

Entering VIC Pool

Almost all of the unexpanded VIC's memory is used for the program and variables. Do not add any unnecessary spaces. REM statements mark the beginning of subroutines; don't delete them unless you change the GOSUBs accordingly.

If you prefer not to type in the program, I'll make a copy of the VIC version on tape on receipt of a blank tape (sorry, no disks), a prestamped mailer, and $3.

Joseph Woyton
106 Braddock Drive
Mauldin, SC 29662

See program listings on page 124.

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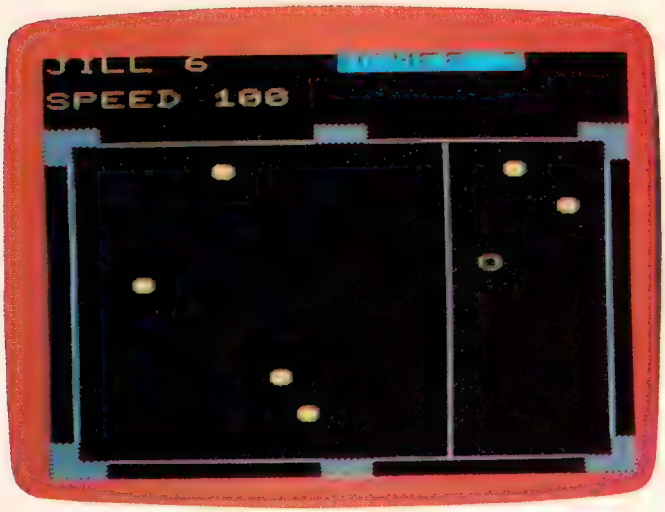
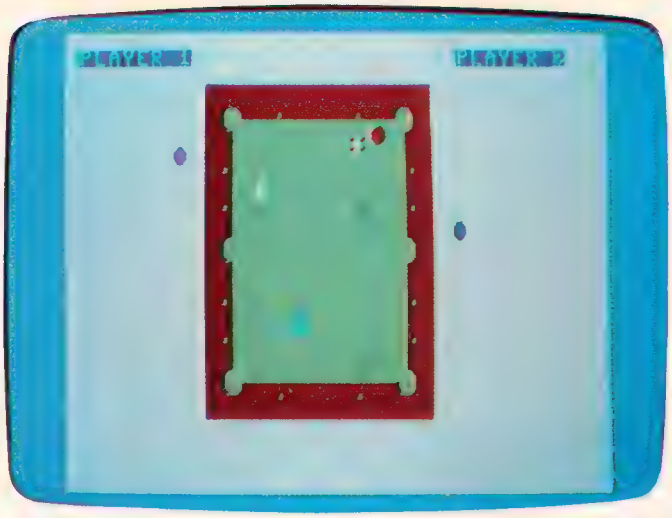


After a scratch, the cue ball is placed anywhere behind the line (VIC version).



Player 2 carefully plans a shot—red ball in the corner pocket. (64 version).

Programmer's Notes: 64 Pool

Kevin Mykytyn, Editorial Programmer

Rather than translating the VIC version directly to the 64, an entirely new high-resolution Pool was written. It requires a joystick (two joysticks in the two-player version).

The 64 version is written entirely in machine language, so MLX is required to type it in. If you do not have a copy of MLX (published periodically in the GAZETTE), type it in and save it to tape or disk. Then run it, and enter the following information:

Starting Address: 49152
Ending Address: 52905

When you've finished, save the program. Load it back into the computer using a secondary address of 1: **LOAD "POOL",8,1** (disk) or **LOAD "POOL",1,1** (tape). **SYS 49152** starts the program.

The title screen comes up first, with a ragtime melody playing in the background. You choose a one- or two-player game. The screen clears and the pool table appears.

At the start of the game, the white cue ball is at one end of the table and six balls are arranged at the other end. There are six (rather than 15) because only eight sprites are available on the 64. Using the joystick, position the cue ball in the "kitchen," behind the scratch line. When you're ready to shoot, press the joystick button once. A crosshair appears on top of the cue ball.

Move the crosshair in the direction you want to shoot. Unlike the VIC version, which has eight directions of movement, 64 Pool allows you to shoot in any direction. Pressing the joystick button starts the cue ball rolling.

The distance between the cue ball and crosshair determines the strength of the shot. The farther away, the harder the shot. There is a limit on how far you can move the crosshair (approximately two-thirds the length of the table). On the initial break, you'll probably want to shoot hard. On later turns, the strength of the shot will determine how far the cue ball travels after a collision. Strategic soft shots can help you set up the table for the next shot.

The goal in the one player game is to clear the table in the fewest number of shots (the record here at COMPUTE! Publications is eight). When all balls are in the pockets, you're ranked according to your ability, from Pro (the best) to Pool Shark, Amateur, and Novice.

In the two-player game, you try to outshoot your opponent. When you sink a ball, it's placed on your side of the screen. With six balls in play, tie games are possible.

A scratch occurs when you knock the cue ball into a pocket, or when the cue ball doesn't hit anything before coming to a stop. You lose your turn, one of the balls to your credit is put back on the table, and the cue ball is placed in the starting position. Your opponent can then put the cue ball anywhere behind the scratch line.

64 Pool does not completely follow the laws of physics, although it offers a realistic simulation. The sprites are moved pixel by pixel, but the movement is calculated in 256ths of a pixel for increased accuracy.

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COMMODORE 64

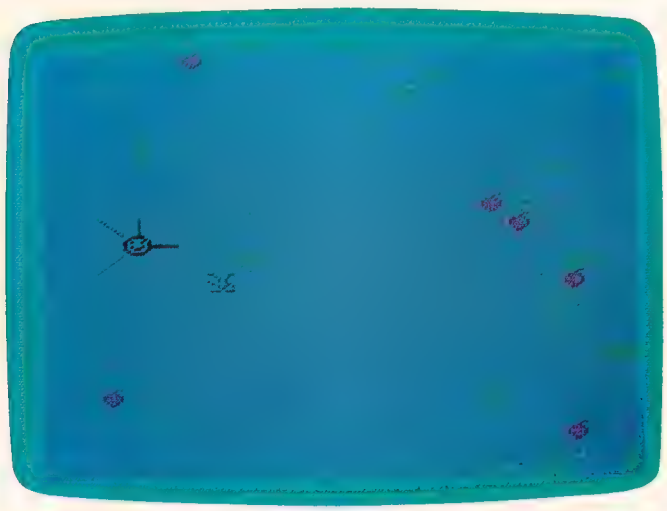
Apple Hunt

James Arlet

Speed is important, but good strategic moves will ensure success in this clever game for the VIC and 64. A joystick is required.

As the main character in "Apple Hunt," you find yourself in a forest with apples scattered here and there. Your job is to eat as many as you can. However, you must avoid the trees and the moving monster, who is fond of devouring everything—apples, trees, and you. You're also working within a time limit, so lengthy pauses to study the situation are not advisable. The key to success in this game is to think before you move—but don't think too long.

Your sole weapon in this game is the "zap," which clears out everything in the adjacent eight screen locations. It's activated by pressing the fire button. You can use it to clear out trees to get to an apple or use it to zap the monster. Occasionally, a ruby appears on the screen. You must try to get it before the monster does—it's worth a lot of points.



An unsuccessful attempt to "zap" the monster (VIC version).

Game Play

When you run the program, you'll be asked if you want game instructions. Press Y to read them, N to get right to the game. Using a joystick (port 2 for the 64), move your man toward the apples or ruby, and use your fire button to "zap." Notice that you can wrap around the screen from all four sides—a feature you'll need to use.

You begin with two men and two zaps in wave 1. To complete each wave, you must eat five apples, pick up a ruby, or zap the monster—any of these within the time limit. Each new wave includes more trees, making maneuvering progressively more difficult. Before the time expires, the screen will flash red indicating a few seconds left. Using a zap (if you haven't used both of them) resets the time to zero for that wave. If you eat four or less apples, then lose a life, those collected carry over to the next wave. This does not happen if you collect a ruby or zap the monster.

VIC Notes

The VIC version of Apple Hunt is in two parts. Type in Program 1, "Redefined Characters," and save it. Then enter Program 2 and save it with the filename "P2". Tape users should save Program 2 immediately after the first. Disk users should change the 1 to an 8 in line 470 of Program 1, and delete line 450.

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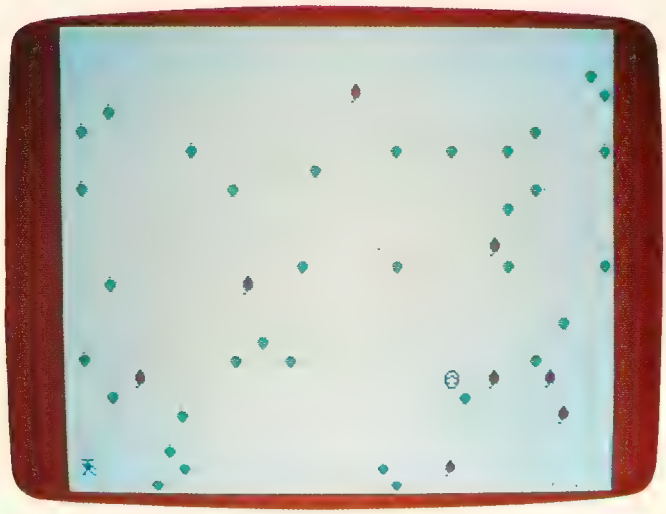

Moving left toward the apples (64 version).

Points are awarded as follows: 50–500 for apples, 1000 for zapping the monster, and 3000 for a ruby. Bonus points are given according to how fast you complete a wave. If you finish a wave *after* the screen flashes red, no bonus points are given. Also, an extra man and an extra zap are given after completing waves 5, 10, 15, 20, and 25. The highest score to date is 104,753.

See program listings on page 133.

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Features That Won't Quit

With the GP-550CD your computer can now print 40, 48, 68, 80, 96, or 136 characters per line. You can print in ANY of 18 font styles. You not only have the standard Pica, Elite, Condensed and Italics, but also true Superscripts and Subscripts. Never again will you have to worry about how to print H_2O or X^2. This fantastic machine will do it automatically, through easy software commands right from your keyboard. All fonts have true descenders.

One of the fonts we like best is "Proportional" because it looks most like typesetting. The spacing for thin characters like "i" and "l" are given less space which "tightens" the word making reading easier and faster. This is only one example of the careful planning put into the GP-550CD.

Do you sometimes want to emphasize a word? It's easy, just use **bold** (double strike) to make the words stand out. Or, if you wish to be even more emphatic, underline the words. Or do both. You may also wish to "headline" a title. Each basic font has a corresponding elongated (double-wide) version. You can combine any of these modes to make the variation almost endless. Do you want to express something that you can't do with words? Use graphics with your text — even on the same line.

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It's hard to hit the wildly bouncing spaceships in "AstroPANIC!"

Astro-PANIC! For The VIC

Sean D. Wagle

In the February 1984 GAZETTE, we published Charles Brannon's "Astro-PANIC!" for the 64, a popular game with our readers. Sean D. Wagle, a 16-year-old programmer, has created a version for the VIC. It's all machine language, and is faithful to the original 64 version. We think you'll be surprised at this unique programming accomplishment. The program has smooth and lightning-quick movement, excellent playability, and sprite emulation—all on the unexpanded VIC. A joystick is required.

As the name implies, "Astro-PANIC!" is a frantically paced space game. The pace gets faster and faster the longer you're able to survive. The object is simple: With a joystick, you must defend your cannon, at the bottom of the screen, by maneuvering it left and right while trying to destroy a fleet of alien saucers which dodge and dive unpredictably in a furious attack. You have only three ships (two in reserve at the start of the game), and there are 15 levels, each increasingly difficult. Your goal is to make it through Level 15. If this challenge is too much initially, you can play for the highest score.

If you survive through Level 15, the game loops back to Level 1, where the pace slows down. Only a few will make it this far, however. If you wish to pause the action, press the SHIFT LOCK key. Press it again to resume play. To begin a new game at any time, press any alphabetic key.

Typing In The Game

Astro-PANIC! is written entirely in machine language and requires VIC MLX (published in alternate months in the GAZETTE) to type in. After entering and saving VIC MLX (8K or greater required), turn off your computer, but leave the memory expander inserted. Now, turn your VIC back on and type **POKE 44,30:POKE 7680,0:NEW**. Load MLX and type RUN. At the starting and ending address prompts, enter 4608 and 7679, respectively. Next, type in Astro-PANIC! and save it. Turn off your computer, remove the expansion cartridge, and then load the game with this format: **LOAD "filename",8,1** (for disk) or **LOAD "filename",1,1** (for tape). To start, type **SYS 6560**.

See program listing on page 130.

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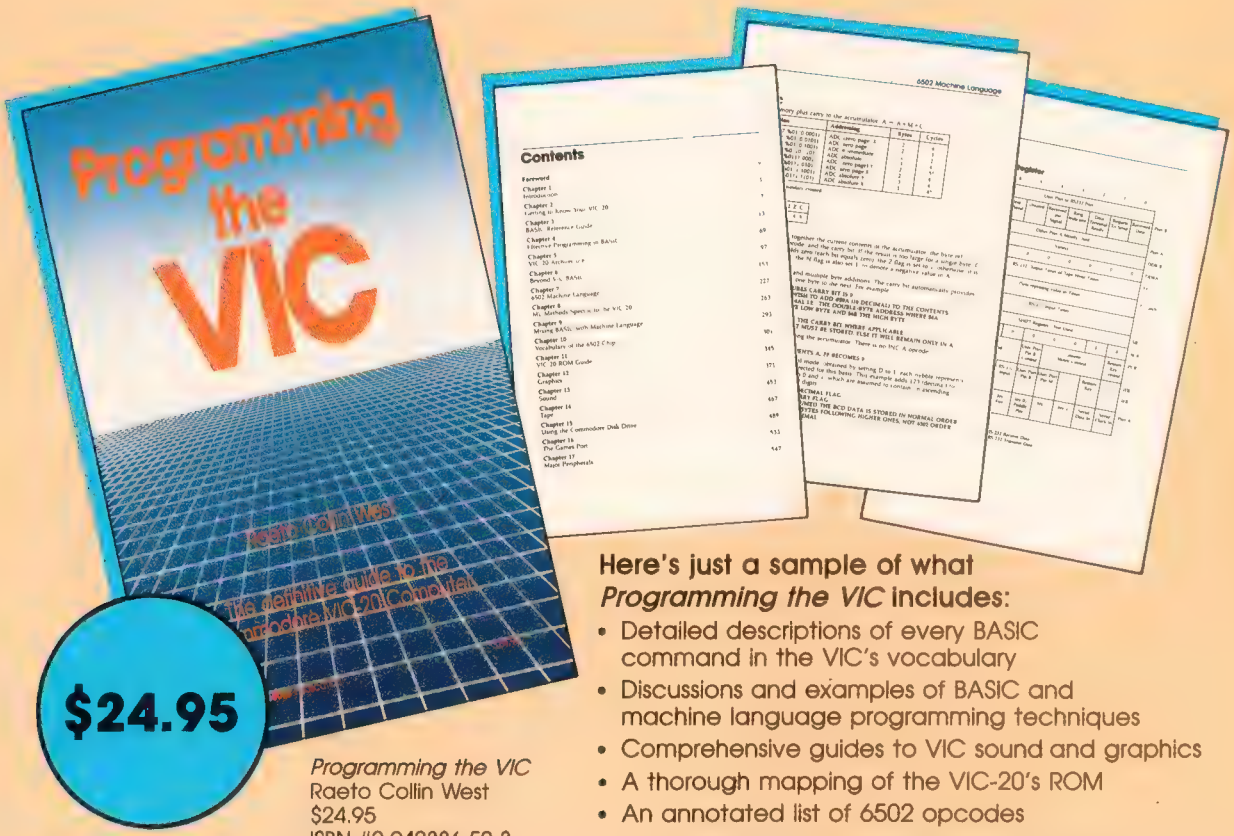

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The World Of Mimi The Ant

Fred D'Ignazio, Associate Editor

What Is A "Fourmi"?

Recently I received a letter from Monique Gosselin of Logidisque in Montreal, Canada. Monique asked me to take a look at a program called *Mimi* by Anne Bergeron. *Mimi* is an early-learning program for the Commodore 64 that Logidisque had just begun shipping.

I unpacked the program from the mailing wrapper, but when I saw the program's manual, I panicked. The manual was short enough—only eight pages—but it was written entirely in French.

Luckily, my five-year-old son Eric was hanging around, and he spotted the cartoon on the front of the documentation. It looked like a little child playing a flute. Except that the child had antennas.

"What's that?" Eric asked.

"I don't exactly know," I told Eric. "Except I don't think it's human."

I looked at the directions. The program's title said, "MIMI: Les aventures de Mimi la fourmi."

"Mimi's a 'fourmi,'" I told Eric.

"What's a fourmi?" Eric asked.

I knew he would ask that. "Just a second," I told him. I ran upstairs and dug a French-English dictionary out of my daughter's bookcase. I looked up "fourmi" and found that it was an "ant."

A Visit To Mimi's World

"C'mon," I told Eric, when I returned to the computer. "Let's take a look at Mimi."

Eric and I booted the *Mimi* disk and entered Mimi's world.

Mimi's world was quite simple. At the lower lefthand side of the screen was Mimi's house. The house was cut away on the side so that we could see in. A pathway led from Mimi's house to a bridge over a tiny stream. Past the stream

Day ("jour") . . .

and night ("nuit") in Mimi's world.

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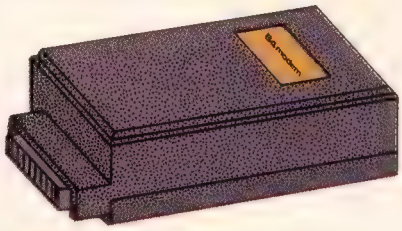

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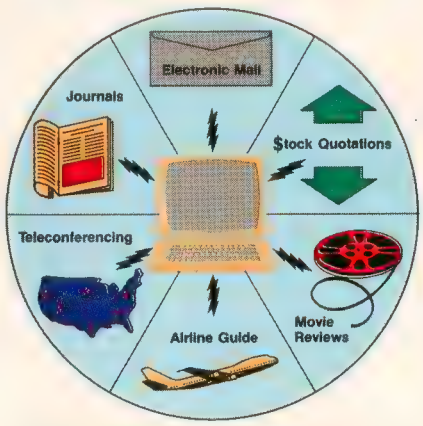

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the path wound around a tree and out of the picture. In the lower righthand part of the stream was a pond fed by the stream.

The picture was simple, but it was well-drawn and had a charming, storybook character. Mimi, too, was appealing. She walked upright and was dressed in overalls and bare feet. Except for her antennas, she resembled a child more than an ant.

Joining Mimi in her world were a worm (le ver), dancing snails (les escargots), a bee (l'abeille), fireflies (les lucioles), and butterflies (les papillons). Since Eric and I couldn't understand the directions in the manual, we began randomly pressing keys on the Commodore. It didn't take us long to figure out that what we were watching was an animated, choreographed picture book accompanied by music. Each time we pressed a key, Mimi or her friends would do something different.

At first Eric and I just experimented by pressing the different keys and watching what happened. Soon, however, we wanted to repeat certain keys, so I opened the manual and discovered a summary of the letter keys and their associated scenes and music.

I had a smattering of French in college, and the descriptions were simple and brief, so I began to understand a little of what was going on. "Push N for nuit," I told Eric. Eric pressed the N key and the sun set, and the moon came up; it became "nuit."

"Press J for jour," I said to Eric. He pressed J and the moon set, and the sun rose. Once again it was "jour."

About that time something magical began happening. Eric and I had traveled into many different microworlds inside the computer, but somehow entering Mimi's world was different. Maybe it was because the "keys" to the world were all in French, and they seemed romantic and mysterious.

Or maybe it was the music, which was unlike anything we had heard on the Commodore 64. It was simple but very fresh and uplifting—something that I associated with a good movie or video animation for children. Along with familiar songs like "Happy Birthday" ("Bonne Fête") and "Frère Jacques," there were many new songs like "Poire, Poire," "Abricot," "Dame Tartine," and "Roi Dagobert," and "Extrait de la Sonate no. 1 de J. S. Bach." Later, I learned that the songs were a mixture of popular French nursery rhymes, folk songs, and classical melodies.

Perhaps the most entrancing part of the program was its seeming ignorance of the heated debate about children's software. Almost all the educational software my children and I had seen was either game-oriented, drill and practice, or a "tool kit" or "builder kit." But *Mimi* wasn't any of these things. There was no sense of Mimi or her world being mechanically contrived to "motivate" or "educate" a child. Instead, Mimi and her world simply existed. And by being natural (like the characters and scenes in a good movie or picture book), they beckoned Eric and me to believe in them and to enter their world.

Perhaps the most magical scene in the program is when the child presses the R key for rêve (dream) after pressing the N key for nuit (night). Mimi walks over to her bed, lies down, and goes to sleep in her darkened house. Then Mimi's dream begins and a "dream Mimi" floats out of bed, up through the ceiling of her house, and up into the sky. Mimi lands on the crescent moon and swings while the computer plays "Ah! vous dirais-je Maman" ("Twinkle Twinkle, Little Star"). Then, the dream Mimi goes back into her body, and the dream ends.

Learning French With Mimi

When Eric pressed B, Mimi took a baignade (bath) in the pond. When he pressed D, Mimi did a danse (dance) on the bridge with the little ver (worm). While the ant and the worm danced, the computer played the familiar French tune, "Sur le pont d'Avignon."

In each case, the letter Eric pressed corresponded to the first letter of a French word. As Eric and I played the game, we began talking more and more in French. I began reading the French directions in the manual out loud, and we began referring to the scenes by their French names: Miel (honey), Violettes (violets), and s'Habille (Mimi gets dressed).

Some of the letters—and scenes—only work in daytime or nighttime, and if Eric tried to do them without pressing the J (jour) or N (nuit) key first, I would get excited and shout, "No, jour!" or "Nuit!" The crazy thing is that Eric understood me and made Mimi's world turn into day or night.

Eric's two favorite scenes were Mimi's dream (le rêve) and when the little worm sneaks into Mimi's house and hides (se cache) in Mimi's closet. Eric would press Q to make the worm (le ver) hide, and U to make the mischievous little fellow pop out of the closet and surprise Mimi.

The Mimi Storybook

After a week of playing *Mimi* daily, Eric and I finally discovered that by pressing the + and − keys, we could speed up and slow down the scenes. This produced some humorous effects and revived Eric's interest in several of the scenes.

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Anne Bergeron, seated between two admirers, and her brother, Eric Bergeron.

A couple days later, Eric was fiddling around with the Commodore 64 keyboard, and he stumbled into a menu with four activities. After experimenting, we found that Memoire Courte (Short Memory) would let us create a Mimi "story" by letting us record a sequence of two scenes in the computer's memory. Memoire Longue (Long Memory) let us create an ambitious Mimi story with up to ten scenes. When we chose Retour à Mimi, the computer returned us to Mimi's world. When we pressed the f7 key, the computer started the story. (We learned we could stop the story by pressing the f5 key.)

To actually create a story we had to choose the Enregistrement (Recording) option. Then we reached a second menu. By making choices from this menu, we found we could press several letter keys and compose a new story, or press the cursor keys and the DEL key and edit an existing story. We could attach speeds to each scene in the story by pressing the + (speed up) or − (slow down) key.

A Conversation With *Mimi's* Author

I had the opportunity to have lunch with Anne Bergeron, the author of *Mimi,* while I was in Montreal as a speaker at the second international "Computers in Education" conference sponsored by McGill University. I bumped into Monique Gosselin of Logidisque and she arranged for me to interview Anne over lunch the following day.

Bergeron turned out to be just as fascinating as Mimi. She was a mother, a mathematician, and a programmer. She told me that she had bought a Commodore 64 only two years earlier as a gift to herself for Christmas.

The computer was supposed to be her toy, but as soon as she sat down at it, her 18-month-old daughter Aleck wanted to climb in her lap and bang on the keys. Anne let Aleck bang, and she also began searching for a program that would be appropriate for Aleck to use. After failing to find anything worthwhile, she gave up the search and set out to write a program of her own.

During the day, Anne worked as a mathematician, and her daughter went to day care. At the end of the day, Anne would pick up Aleck and her three-year-old niece Anouk, and they would go home. She worked with Aleck and Anouk at least a half hour every night, asking them what they would like to do on the computer and letting them test different children's programs she was writing.

When Anne began writing *Mimi,* she knew nothing about programming, and she didn't know English. She soon gave up on programming manuals, and began reading COMPUTE! to learn how to program. Less than a month later, she grew frustrated with how slowly her programs ran in BASIC and she began learning machine language.

Over the next six months, *Mimi* began to take shape. Anne listened carefully to her daughter and her niece's suggestions, and watched them play with *Mimi.* At lunch she told me, "They had lots to say. Sometimes just one question presented me with a whole week of new programming."

The kids' questions and suggestions continued, but after six months Anne was finished—

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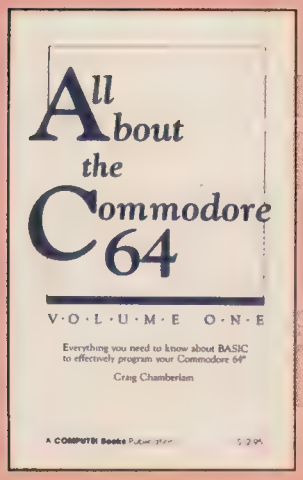

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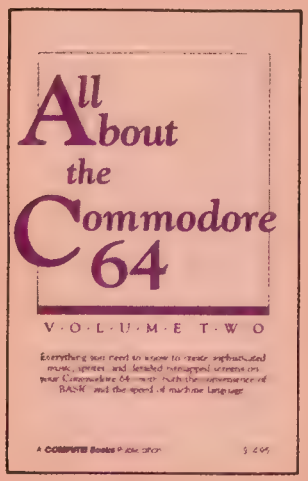

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except for the music. "I knew nothing about music," Anne said. "But my brother Eric did."

Anne enlisted her 16-year-old brother's help, and they tracked down 26 songs that they could match with the 26 letter keys on the computer keyboard. Eric arranged all the songs, and he and Anne programmed them in machine language.

A New Mimi

Last summer *Mimi* competed along with 300 other programs from all over the world and won a special prize at the Avignon International Software Festival. Anne and Eric went over to the SICOB Trade Show in Paris in September and accepted the prize in *Mimi*'s honor.

Mimi's success led Anne to start working on *Mimi Two*, which she says may be published very soon. Working with Anne on the new *Mimi* program is Pierre F. Brault, the composer and musician who creates the music for Canada's acclaimed "Passe-Partout" TV program for young children. According to Anne, "Passe-Partout" is Aleck's favorite program. It's the French equivalent of Sesame Street. Pierre is composing all original computer music for *Mimi Two*, and the program will begin with a song entitled "The Mimi Symphony."

The Inner *Mimi*

Part of the magic of *Mimi* is the program's gentleness and accessibility, even to a very young child. According to Anne, "In *Mimi*, there is no concept of right or wrong answers. Everything a child does is constructive."

Anne says she started out thinking of *Mimi* as a book. "Each scene is like the page in a book," she said. "But then I saw that it was more than a book. In *Mimi*, you can mix up the pages. You can make up your own books."

Anne continued: "Actually, *Mimi* is a little film. When I watched TV with Aleck, she always wanted me to reverse the show, so she could understand it. But she can do that with *Mimi*. She can slow *Mimi* down. And she can play *Mimi* over and over until she understands each scene."

I asked Anne how Aleck and her cousin Anouk used *Mimi*. She said that, despite appearances, *Mimi* was not software for learning letters; that was a side effect.

"*Mimi* is there for discussion," said Anne. "The child needs someone there to talk to and discuss what happens when she presses a certain key.

"Little children can use *Mimi* to learn how to talk, sing, dance, construct a story, and impress friends."

"Impress friends?" I asked.

"Aleck is only three and a half," said Anne, "but she is an expert on *Mimi*. When a big kid (someone 5 or 6) comes over, Aleck is the teacher. She announces a *Mimi* scene before it happens, and she feels important. 'Look at what Mimi can do!' she says."

"Will *Mimi Two* be like *Mimi One*?" I asked.

"Now that I am done, *Mimi One* looks easy," Anne says. "*Mimi Two* will be much better. It will be baroque—each time children look at it they will see something new and delightful. There will be a *Mimi* disco that encourages children to dance with their friends. And there will be all sorts of guessing games for *Mimi* and the children to invent."

An English *Mimi*, Too

Mimi runs on the Commodore 64 computer with a disk drive. It now comes in English as well as French (though I would still recommend the French version). Each version costs $34.95.

To order *Mimi* or to find out more information, contact:

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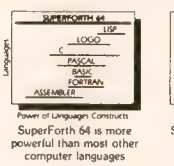

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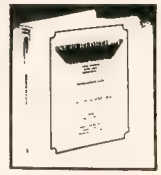

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This hint can be a number indicating how many times greater or smaller the answer is. For example, if the correct number is 75 and you guess 15, the computer responds 5 TIMES TOO LOW. But if your guess is less than two times greater or smaller than the correct number, the screen displays TOO HIGH or TOO LOW.

You can guess any number from 3 to 100. If you guess correctly within the allotted five turns, you see a skydiver descend safely to the ground. But if your quest is unsuccessful, the skydiver plunges into a lake.

The hints offered in Number Quest make it a useful program for teaching multiplication and division. By entering 3 for each new number, for instance, you get a drill of the "threes" times table.

Numbers 1 and 2 are illegal guesses—many children can easily figure out that entering 1, for example, will give them the answer on the next turn. If 1 or 2 is entered, the computer responds with THAT'S TOO EASY!

If you wish to modify the number of guesses (5) in the 64 version, change the 5 in line 250 and the value for TN (6) in line 500. The 6 in this statement indicates that TN (for Turn) has gone over 5. In the VIC version, change the 5 in line 170 and the value for TN in line 380.

See program listings on page 138.

A correct guess allows the parachutist to descend on the landing pad instead of in the drink (VIC version).

The clues in "Number Quest" teach children math concepts (64 version).

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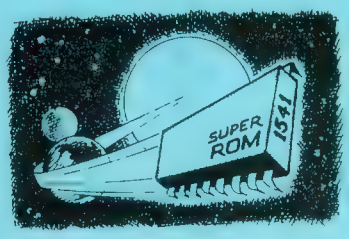

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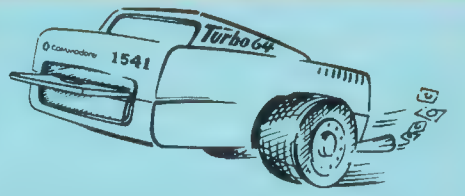

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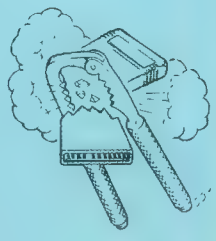

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Programmer's Notebook

Paul Barnes

If you've discovered a clever timesaving technique or a brief but effective programming shortcut, send it to "Hints & Tips," c/o COMPUTE!'s GAZETTE. If we use it, we'll pay you $35. Due to the volume of items submitted, we regret that we cannot always reply individually to submissions.

When you're programming, it's helpful to keep reference materials close at hand—books, memory maps, copies of computer magazines, a list of CHR$ values, the Programmer's Reference Guide, and so on. Ironically, some of the most creative and logical programmers work in the midst of chaos. They may discover a useful POKE and write it down on a scrap of paper. But two days later, the note is buried somewhere in a pile of books, magazines, and other notes. "I know it's here somewhere." Sound familiar?

A three-ring notebook can eliminate some of the mess. Whenever you find a new technique or programming shortcut, write it down in the notebook. You can also jot down ideas for modifications and improvements to programs you've written.

Here are a few techniques I've collected; they'll get you started on your own Programmer's Notebook. With the exception of 64 Emergency Joystick, all the following programs work on both the VIC and 64.

A One-Line GET

When you want the user to choose something from a menu, you wait for them to press a key and then continue. The most common way is to GET a character:

```
100 GET A$: IF A$="" THEN 100
110 IF A$="Y" THEN 500
```

An easier way is to use the WAIT statement. Location 198 keeps track of how many characters are in the keyboard buffer. So replace the two lines above with one:

```
100 WAIT 198,1: GET A$: IF A$="Y" THEN 50
    0
```

What's The SYS?

Have you ever forgotten the starting or ending address of a machine language program? There's a way to figure out where an ML program loads into memory.

If you're working with a Datassette, position the tape so the next program is the one you want to check. Then, in immediate mode, type **OPEN1:CLOSE1**. Opening a program or data file copies the program header into the cassette buffer. And the header contains information about where the program should be loaded. Next, type **PRINTPEEK(829)+256*PEEK(830)** to get the starting address and **PRINTPEEK(831)+256*PEEK(832)** for the ending address.

The first two bytes in a disk program file indicate the starting address. Disk users can enter the following program to read these two numbers:

```
10 OPEN 2,8,2,"PROGRAM NAME"
20 GET #2,A$,B$: Z$=CHR$(0): CLOSE2
30 PRINT ASC(A$+Z$)+256*ASC(B$+Z$)
```

Now you have the starting address. To find the ending address, LOAD*"filename"*,8,1 and then **PRINTPEEK(45)+256*PEEK(46)**.

Automatic LOAD And RUN

If you don't specify a device number (a disk drive is device 8) when you load or save on a Commodore computer, it defaults to tape.

SHIFT-RUN/STOP automatically loads and runs the next program on tape. Apparently you can't use this feature if you have a disk drive.

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But you can; try this:

LOAD *"filename"*,8:

Make sure you put the colon just past the 8. And don't press RETURN. While the cursor is blinking to the right of the colon, hold down the SHIFT key and tap RUN/STOP. The word LOAD appears and the program loads from disk. Once it's in memory, it automatically runs.

Also, if you don't like typing long program names, you can load them right from the disk directory. LOAD"$",8 and then LIST to see the directory. When the program name appears on the screen, press RUN/STOP. Cursor up to the beginning of the line with the program name and type LOAD. Then cursor right, just past the second quotation mark and type ,8: (again, be sure to include the colon). Press RETURN and the program loads. And you didn't have to type the program name.

Undimensioning Arrays

Arrays can take up a lot of memory. By changing the array pointer, you can clear the array space without affecting other variables. Try this program:

```
10 DIM A(100)
20 POKE 49, PEEK (47): POKE 50, PEEK (48)
30 DIM A(10)
```

Without line 20, line 30 would return a REDIM'D ARRAY ERROR. A couple of POKEs is all you need to erase all arrays, freeing up memory (or allowing you to redefine and redimension arrays).

IF-THEN-ELSE

On an IBM PC, you can use lines like 10 IF A=5 THEN PRINT A ELSE PRINT "NOT 5" where ELSE works like an "otherwise." IF-THEN-ELSE is not available on the VIC or 64. Or is it?

Normally, if the condition is not true, the computer drops through to the next line. Using ON-GOTO instead of IF-THEN, you can simulate ELSE and stay on the same line.

```
10 FOR A=1 TO 6
20 ON - (A=5) GOTO 30: PRINT "NOT 5--ELSE
   " :GOTO 40
30 PRINT A
40 NEXT
```

The statement (A=5) is evaluated as 0 if it's false, and as −1 if it's true. If A=5 is true, the program goes to 30. Otherwise, it continues to the statement after the colon, rather than falling through to the next line.

Blinking Cursor For GET

If you prefer GET to INPUT, but want to see the cursor blinking, here are a couple of POKEs that do the job:

```
10 POKE 204,0: WAIT 198,1: GET A$
20 POKE 205,3: WAIT 207,1
30 PRINT A$;: GOTO 10
```

Line 10 turns on the blinking cursor and waits for a keypress. After the user presses a key, line 20 waits until the cursor is off (to avoid reverse characters). The character is then printed to the screen and the program goes back to line 10.

64 Emergency Joystick

You may have left your only joystick at a friend's house. Or perhaps it broke when you were defending the planet from nasty aliens. If you need an emergency substitute for the joystick, try using these keyboard equivalents:

Direction	Joystick #1	Joystick #2
down	back arrow	CTRL-A
up	1	CTRL-(CRSR RIGHT)
left	CTRL	CTRL-D
right	2	CTRL-6
fire	space	CTRL-J

It seems a bit awkward at first, but you do get used to it. This technique works because the keyboard and joystick share some input lines. This is convenient when you need to simulate joystick movement, but it can cause problems. If static electricity sparks against the joystick port when you reach to turn on your 64, you may zap the chip that reads the keyboard. The only way to repair it is to replace the chip.

PRINT@

Two memory locations keep track of the cursor location in X and Y coordinates. The number in 211 is the column number. Location 214 holds the row number. You can PEEK these locations to find out the screen position of the cursor. Or POKE to these locations to simulate the PRINT@ command available in some versions of BASIC.

```
10 PRINT CHR$ (147)
20 POKE 214,9: PRINT
30 POKE 211,19: PRINT"LINE 11, COLUMN 20"
```

First the screen is cleared. Next, in line 20, we put the cursor at line 10 (the top line is number zero, so nine is actually the tenth screen line). Every time you POKE 214, you must PRINT a blank line for the message to work correctly. We're now a line further down, on row eleven. Finally, the cursor goes to the twentieth position and a message is printed.

These tips are helpful, but they're not much good if you can't find them when you want to put them to use. A Programmer's Notebook is a handy way to keep track of useful techniques. @

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REVIEWS

Dream House

Several years ago, I started a doll house kit. I laboriously laid out all the wood parts and followed instructions to build the doll house. Although I enjoyed working on it, I never completed the project. We've moved several times since then, and each time I've had to carefully hand carry that doll house.

Dream House, developed by Joyce Hakansson Associates for CBS Software, is a less bulky way to build a house—either a doll house or your own "real" house.

You can be an architect, a landscaper, and an interior designer. Four basic styles of houses are included: the Colonial Farmhouse, the San Francisco Victorian, the Manhattan Penthouse, and the Hideaway Cottage. Choose one of these basic houses, or start with one of the houses and customize it. Each of the houses has a floor plan you can view, then you can go into the individual rooms to paint and decorate.

You can choose indoor and outdoor furnishings, landscape the yard, and put furniture inside. You can even use the workshop to build your own furniture. Several of the objects are animated. For example, I put a birdcage in one living room scene, pressed the animation option, and a bird started swinging and chirping.

The introductory music is fun, and the graphics are superb. The strength of this program, however, is its

educational value. Children can learn to read a floor plan and relate that floor plan to the different perspectives of the house. They can have fun with color in designing, and they can manipulate the objects within a design plan.

The manual ("Designer's Guide") is well-written and easy to understand. It contains step-by-step examples you can follow before designing your own house. After completion, you can save the interior or exterior (or both) from those screens. Later you can load your design to continue work on it.

Dream House is recommended for ages eight and up. There's a wide variety of shapes and options available to keep children interested. With computer-aided design, you can be creative without a lot of hassle. The manual suggests several activities for using the program with several people, such as building cooperatively and discussing different approaches or playing hide-and-seek by using different colored paints. This program can provide many hours of fun, enjoyment, and the feeling of creative accomplishment.

—*C. Regena*

CBS Software
One Fawcett Place
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Sargon III

This sequel to the popular *Sargon II* chess program is an even tougher opponent and adds a smorgasbord of features.

Select from nine levels of difficulty with an average response time ranging from five seconds per move on level 1 to ten minutes per move on level 8. On level 9, the computer keeps thinking until you stop it, at which point it plays the best move it has found. On any level, the computer continues to think while it's waiting for your move, thus strengthening the computer's play. This feature can be turned off by selecting Easy Mode, effectively doubling the number of levels.

During the opening, the computer plays "book" moves based on a huge library of over 68,000 positions. An opening library that size is usually found only on mainframe computers.

Additional features make *Sargon III* more friendly than its predecessor. You can take back moves, set up any position, change sides with the computer, review all the moves of the current game from the beginning, save a game to disk, print out the move list or current position, and even ask the computer

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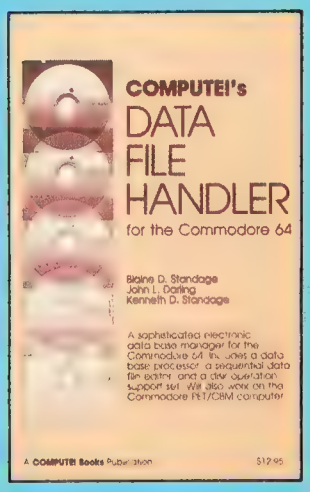
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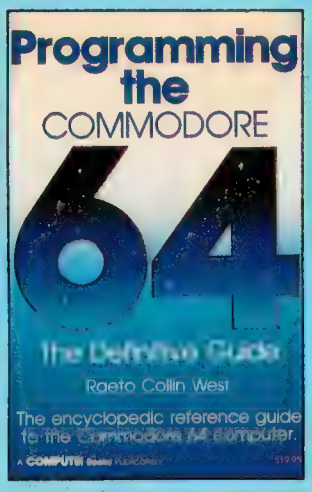

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to suggest a move for you. You can also play a friend and let the computer act as referee. The "Window On The Search" lets you see the moves the computer is considering as it thinks.

Sargon III fills both sides of the disk. On the flipside are 107 of the greatest chess games ever played from 1851 to the present. Each of these can be loaded and replayed move by

move. Other positions stored on the disk are used along with the manual to illustrate the opening moves, strategy and tactics, endgame play, and checkmate situations.

The 80-page manual thoroughly explains each feature and includes a summary of the rules of chess.

—John Krause

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Turbo 64

Many car racing games tend to get old rather quickly. They're exciting at first, but end up on the shelf in a short time. *Turbo 64* may be a break in that pattern. Limbic Systems calls its program "a thrilling second-generation racing car simulation." Note the word *simulation*. Although it is a game, it's also a well-designed simulation—not for those who expect to make their madcap way through a crowd of howling cars and frequent random explosions.

It's available on disk or tape, and at a most reasonable price. Those who buy the cassette version get a bonus. Through the use of a special system, the game loads in only four minutes. Conventional tape loads of comparably complex programs can take five to ten minutes longer.

Once into the game, there are a number of choices. You must decide between two widely differing racing circuits, choose whether you want automatic or manual shift, set the number of laps and the drivers who will be competing over them (nine is the maximum in both categories), and determine whether you want joystick or—surprisingly—keyboard control.

With the preparations out of the way, you wind up on the track of your choice—alone. It's important to remember that this is a Formula 1 (Grand Prix) simulation. Your highly-tuned car and the twisting, turning track are unforgiving, to say the least. You'll need all the precision and concentration you can muster. At this stage, the display consists of your cockpit instruments, the front of your car, and the open road ahead. Once you're under way, the instruments return information on your speed, engine RPM, gear selection, lap and timing details, and score.

Even with this information, you'll find it hard to stay on the track at first. You can drive on the margins, but you'll lose points, and the accompanying noise is dreadful. Since the car

has been programmed to behave like a Formula 1 racer, it had better be in the right gear when you go around the turns. But if you crash, the program puts you back on the road at the point where you drove off. Of course your score has been reduced drastically, just as it will be for the serious crime of over-revving your engine. This is a real car. And the object is to take it around the track as quickly as you can, without damage.

The graphics in *Turbo 64* are stunning. The displays are all well-designed and detailed. The 3-D effects are smooth and fluid—with the road snaking away toward the realistic

background. The illusion of reality in *Turbo 64* is reinforced by some excellent sound effects. The changes in engine tone are as impressive as the graphics, and they provide you with important clues about the state of your vehicle. Also, pay close attention to the frequent warning signs on the sides of the road. If you do, they can be lifesavers; if you don't, they're only dangerous barriers. On the more difficult track, you may find yourself driving off the road as you become familiar with the various landmarks. There's a delightful mountain community there. If only you could get off the track and into the hills.

But of course you can't; you're a race car driver, and your focus is the road ahead. In *Turbo 64*, that's a difficult road indeed, and you'll need every advantage. Here, the unusual option of playing from the keyboard offers a great deal of help. You can steer the car with two hands, which seems to give much better control than a joystick. In manual gearshift mode, you use the function keys to select gears—which is almost impossible to do with the joystick controls.

Turbo 64 is an excellent piece of software. As a challenging simulation or as a purely entertaining game, its detailed realism and careful design make this one a winner.

—Lee Noel, Jr.

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Stealth

First impressions are often misleading, especially when you're looking at commercial game software. After a while, one tends to put things in pigeonholes. Arcade games, adventure games, strategy games. And subgroupings like shoot-'em-up games, chase games, and maze games come too easily to mind.

Stealth, an arcade game for the Commodore 64 from Brøderbund, suffers from this first-impression syndrome. Glancing at the screen, even playing a few rounds, may give you the idea it's just one more shoot-or-be-shot contest. There are dozens of games already out there like it. At least, that might be what you'd think. Fortunately, it's not true.

Graphically, *Stealth* is outstanding. It has one of the best 3-D views we've seen. You look over the rear and top of a low-flying fighter plane. In the distance are a chain of mountains and the Dark Tower, which looms over the horizon. As you fly toward the Tower, it increases in height. And as you skim the ground, various structures and machines become visible. At first they're only insignificant blurs in the background. But as you get closer, which takes only a moment when you're flying at top speed, they grow larger. Sometimes large enough that they're hard to avoid.

Five levels, the first three of which you can enter when the game begins, test your reflexes and eyesight. You move to the next higher level once you've destroyed the Dark Tower. You have to get there first. Starting 10,000 meters away, you must fly through a collection of radar stations, energy fields, and onrushing opponents. And you

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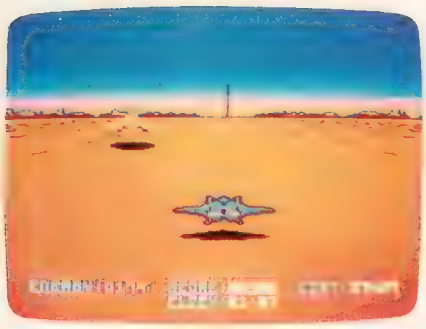

don't have all day to do it. Once your ship's energy is depleted, it implodes. The only way to refuel is to fly through the positive (colored yellow) energy fields. Avoiding the red fields, which sap your fighter's fuel, is a major problem. Of course, you can shoot the oncoming scouts, fighters, missiles, bunkers, and tanks, but that too depletes your energy reserves.

So you point your ship's nose at the Dark Tower, push the joystick forward, and hope for the best. Flying at top speed like this is dangerous, for you don't have much time to react, especially when the machines start to come at you one after the other (often hiding behind each other). But at least you have a good chance of reaching the Tower before your fuel is gone. Once you've closed the distance (an indicator keeps track of how far away you are), you have to line up exactly with the structure. One hit is all it takes in the first level; each succeeding level requires an additional hit to bring the Tower down and make the mushroom-like cloud appear.

Stealth is addicting. You're so involved with the action that it's hard to tear yourself away from the screen. This game may fit in that shoot-'em-up arcade game pigeonhole, but it's one of the best around.

—*Gregg Keizer*

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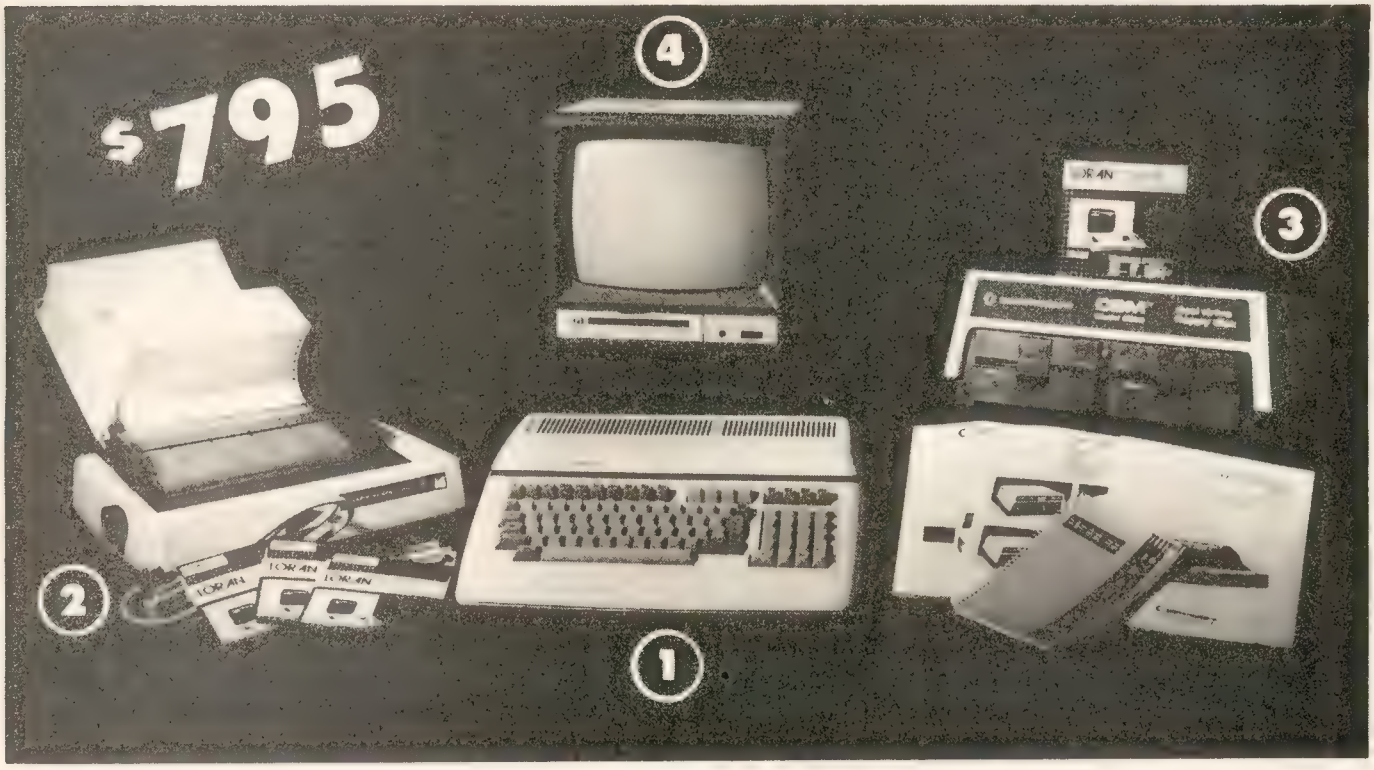

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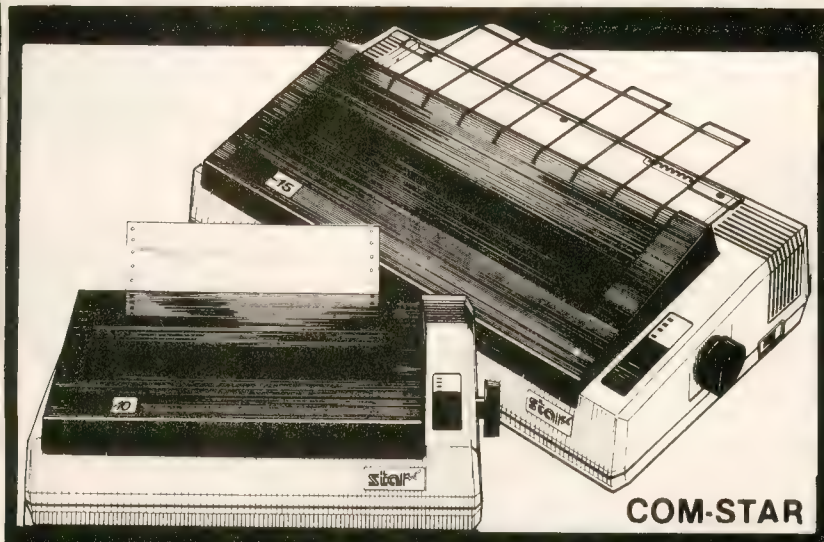

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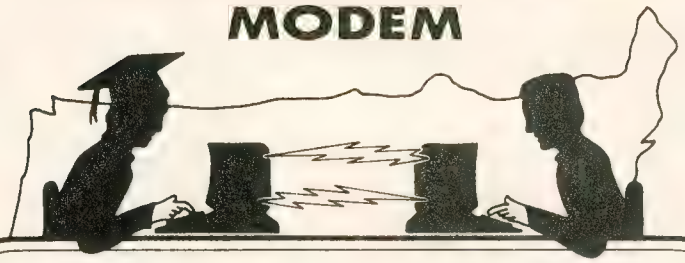

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in the packaging, is simply that "it's not who you know, it's how well you know them."

The 64 version of the program is based on whether you agree or disagree with each of 56 adjectives when applied to the person you wish to analyze. Is the individual apologetic, secretive, warm, pessimistic, empathetic? From your responses to these adjectives, *Mind Prober* generates paragraphs of analysis under the headings of Relationships, Attitudes Toward Work, Coping With Stress, and What Makes The Person Tick. If your subject is 18 years of age or older, there is a section on Attitudes Toward Sex. For those under 18, that is changed to a section on Attitudes Toward School.

After running numerous tests of *Mind Prober*, it's apparent that the program is surprisingly sophisticated in the ways in which it analyzes data. At times, the results can be uncanny in their accuracy. On other occasions—especially if you don't know your subject very well—the responses can be a bit ambiguous.

The software comes packaged in the back of a 148-page book, of which almost two-thirds is devoted to an introduction on "reading" other people. There are also more than six pages of reference and bibliographical material at the end of the book for those who wish to pursue the subject more deeply. You can begin using the program without having to go through the manual, however. Results can be shown on the screen or sent to a printer.

While no one should take a program like this *too* seriously, it's an intriguing, sometimes addicting, approach to the always interesting study of the people around you. It's also great for parties, or for small groups of people. Just be careful who you're with when you begin analyzing.

—Selby Bateman

Human Edge Software Corporation
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$49.95 (disk)

Financial Cookbook

Electronic Arts has a reputation for supplying good software, and *Financial Cookbook* is no exception. As a smorgasbord of financial programs, this package makes it possible to use an inexpensive Commodore 64 computer and a disk drive to check a wide variety of financial calculations normally handled by more powerful computers. In the context of the program title, *cookbook* means recipes for financial calculations and implies easy use. The name *cookbook* is used all too frequently these days, but in this case it is deserved. There are over 30 recipes ranging from "Understanding Your Marginal Tax Rate" to "Leasing Your Car," each of which is aimed at helping you make sound financial decisions in specialized areas. Other representative topics include "Living on Savings," "How Much Life Insurance," "Interest Rate of Loan," "Early Withdrawal IRA," and "Long-Term Investments."

The process of testing a new program always involves a certain amount of fumbling around, trying to make sense of things that may be obvious to the author but not to a new user. With *Financial Cookbook*, however, I didn't waste much time before I was able to try an IRA calculation and check my home mortgage payment.

I picked recipe 14, "An IRA's Future Value," from the menu. The program requested data, such as the amount deposited per year and interest rate. A short time later, the results were printed on the screen. The figures were as expected.

Using recipe 18, "Mortgage Schedule, Yearly," from the menu, I decided to check the figures I receive from the bank on my home loan. The bank's calculation of the monthly payment was correct. However, the program may not be sophisticated enough to calculate the exact amount of remaining principal in a real situation. For example, there exists an escrow fund for taxes, which receives interest. Consequently, the calculated figures for remaining principal were not exact and only in approximate agreement with the bank's.

For the most part, each recipe is easy to use, and output can be directed to a Commodore or Commodore emulating printer. The 32-page manual

includes a technical appendix, which lists all of the formulas used in the calculations. The body of the manual, however, seems a little disorganized. A good short tutorial, which should come first, is included only after three pages of detail that most people won't need or want until much later.

The program is DOS protected, not easily copied, and may not run on disk drives other than the Commodore 1541. Specifically, it did not run on a system using a BusCard II and a 2031 disk drive.

—*Harvey B. Herman*

Electronic Arts
2755 Campus Drive
San Mateo, CA 94403
Suggested retail, $50 (disk)

Reach For The Stars

Before the advent of computer games, there was a popular and well-designed science fiction board game called *Stellar Conquest*, currently out of print and rarely played. That classic game has now inspired one of the finest computer strategy games available, *Reach for the Stars*.

The game designers have transported the broad scope and strategic interest of *Stellar Conquest* to the computer medium. They've maintained the best parts of the old board game, the planning and economic basis, but they've used the computer to eliminate the tedious areas. *Reach For The Stars* is about the control of star systems. It's subtitled "The Conquest of the Galaxy," but conquest is rarely a viable strategy until the game is nearly half completed. Before that point, players are concerned with maintaining their home star system and whatever neighboring systems they manage to get their hands on.

The game allows up to four players. Learning the game well enough to play takes roughly 30 minutes. But, like all good games, mastering it takes a long time. There are several scenarios and levels of play, and each player's turn is divided into several phases such as Movement, Production, Combat, and Planetary Conquest.

You begin each game in control of a primary planet in a star system. Your first act should be to improve the industrial capacity of your home planet, and to produce explorers to look for other systems to colonize. After you're sure your home planet will survive, you head for a nearby star system suitable for colonization. If no other player has already taken this system, you colonize the best planet and build it to self-sufficiency. You continue this pattern until your empire expands into someone else's, at which point your goal changes. Rather than build an empire, you must now defend it.

Somewhere in the distant corner of a galaxy, your main fighting force is locked in battle with the enemy, while a third party has just entered your near-defenseless home star system. Meanwhile, your major industrial base has been decimated by a series of earthquakes, and a promising colony is beginning to suffer the problems of overpopulation. You realize, suddenly, that your empire is too big, too easy to attack, too hard to defend. What makes this an excellent game is that you control all these complexities with a few simple keystrokes.

Reach for the Stars has much to offer the strategy gamer. It's straightforward in approach, but filled with surprises. It's complex, but highly manageable. Finally, it feels right.

—*Neil Randall*

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Seastalker

As Infocom's first junior level text adventure, *Seastalker* deserves particular attention. Despite the "junior" label, *Seastalker* is not "just for kids." And it doesn't compromise on Infocom's high standards in the slightest way.

What it does is provide initial help for the user and extra coaching along the way, and it does this in a variety of ways.

The game's theme is that of a deep sea adventure, a la *Twenty Thousand Leagues Under*

the Sea. You command a high-tech submarine, the Scimitar, and your ultimate goal is to save the Aquadome, which has come under attack by some type of giant sea monster.

There are numerous subplots to be solved before the final test of skill. To this end, Infocom provides a nautical chart of Frobton Bay, which lies between the research lab and the unknown sea area where the Aquadome resides. They also give you detailed floor plans of your lab and the Aquadome.

Obviously, this provides the gamer with quite an advantage. However, Infocom has been very careful not to reveal too much about these places. *Seastalker* also contains a set of Hidden Clues cards, which are optional in game play. The more experienced (or less frustrated) adventurer may wish to ignore these.

What can't be ignored is the information on the back of each card. Necessary information about the sophisticated equipment found in the lab and aboard the Scimitar is provided on the cards, as is equally important information about each of the crew members.

This also provides a richer flavor for the adventure because personalities are brought into play. Infocom has, for all intents and purposes, created a multi-character adventure that can be controlled by one player.

Other small areas of help are included. For example, on-screen prompts help you use the correct syntax when inputting commands; the first three moves are given to help you get started. It's easy to see why the game is considered Junior Level when compared to *Deadline* or *Sorceror*.

Otherwise, *Seastalker* contains all the elements one has come to expect from Infocom: vividly detailed descriptions, intriguing puzzles, and, of course, goodies inside the package (to reveal them would be unfair). The point system employed in other Infocom games is intact, and the adventure can be solved in any number of ways.

It's important to reemphasize that veteran gamers should not ignore this product. It's an excellent program that will present numerous challenges to the gamer in spite of its billing as a Junior Level adventure. The sea environment, fascinating to explore, and the interaction with other characters give *Seastalker* a different feel from other Infocom games.

—James Trunzo

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How To Type In *COMPUTE!'s GAZETTE* Programs

Each month, COMPUTE!'s GAZETTE publishes programs for the VIC-20, Commodore 64, Plus 4, and 16. Each program is clearly marked by title and version. Be sure to type in the correct version for your machine. Also, carefully read the instructions in the corresponding article. This can save time and eliminate any questions which might arise after you begin typing.

We publish two programs, which appear periodically, designed to make your typing effort easier: The Automatic Proofreader, and MLX, designed for entering machine language programs.

When entering a BASIC program, be especially careful with DATA statements as they are extremely sensitive to errors. A mistyped number in a DATA statement can cause your machine to "lock up" (you'll have no control over the computer). If this happens, the only recourse is to turn your computer off then back on, erasing whatever was in memory. So be sure to *save a copy of your program before you run it.* If your computer crashes, you can always reload the program and look for the error.

Special Characters

Most of the programs listed in each issue contain special control characters. To facilitate typing in any programs from the GAZETTE, use the following listing conventions.

The most common type of control characters in our listings appear as words within braces: {DOWN} means to press the cursor down key; {5 spaces} means to press the space bar five times.

To indicate that a key should be *shifted* (hold down the SHIFT key while pressing another key), the character is underlined. For example, A means hold down the the SHIFT key and press A. You may see strange characters on your screen, but that's to be expected. If you find a number followed by an underlined key enclosed in braces (for example, {8 A}), type the key as many times as indicated (in our example; enter eight SHIFTed A's). To type {SHIFT-SPACE}, hold down the SHIFT key and press the space bar.

If a key is enclosed in special brackets, ⟦ ⟧, hold down the Commodore key (at the lower left corner of the keyboard) and press the indicated character.

Rarely, you'll see a single letter of the alphabet enclosed in braces. This can be entered on the Commodore 64 by pressing the CTRL key while typing the letter in braces. For example, {A} means to press CTRL-A.

The Quote Mode

Although you can move the cursor around the screen with the CRSR keys, often a programmer will want to move the cursor under program control. This is seen in examples such as {LEFT}, and {HOME} in the program listings. The only way the computer can tell the difference between direct and programmed cursor control is *the quote mode.*

Once you press the quote key, you're in quote mode. This mode can be confusing if you mistype a character and cursor left to change it. You'll see a reverse video character (a graphics symbol for cursor left). In this case, you can use the DELete key to back up and edit the line. Type another quote and you're out of quote mode. If things really get confusing, you can exit quote mode simply by pressing RETURN. Then just cursor up to the mistyped line and fix it.

When You Read:	Press:	See:
{CLR}	SHIFT + CLR/HOME	
{HOME}	CLR/HOME	
{UP}	SHIFT + CRSR ↕	
{DOWN}	CRSR ↕	
{LEFT}	SHIFT + CRSR ↔	
{RIGHT}	CRSR ↔	
{RVS}	CTRL + 9	
{OFF}	CTRL + 0	
{BLK}	CTRL + 1	
{WHT}	CTRL + 2	
{RED}	CTRL + 3	
{CYN}	CTRL + 4	

When You Read:	Press:	See:
{PUR}	CTRL + 5	
{GRN}	CTRL + 6	
{BLU}	CTRL + 7	
{YEL}	CTRL + 8	
{F1}	f1	
{F2}	SHIFT + f1	
{F3}	f3	
{F4}	SHIFT + f3	
{F5}	f5	
{F6}	SHIFT + f5	
{F7}	f7	
{F8}	SHIFT + f7	

When You Read:	Press:	See:
←	←	
↑	SHIFT + ↕	

For Commodore 64 Only

When You Read:	Press:	See:
⟦1⟧	C= + 1	
⟦2⟧	C= + 2	
⟦3⟧	C= + 3	
⟦4⟧	C= + 4	
⟦5⟧	C= + 5	
⟦6⟧	C= + 6	
⟦7⟧	C= + 7	
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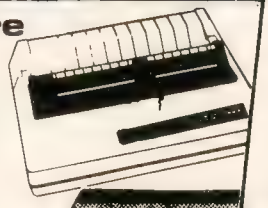

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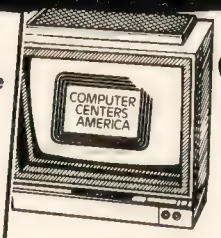

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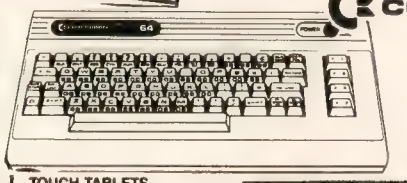

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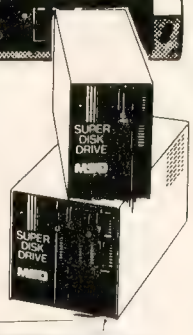

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Bug-Swatter:
Modifications And Corrections

• The article describing "Kablam!" (January) included two sets of instructions for VIC owners.

Readers who used a tape drive, 8K expansion, and VIC MLX will have problems because Kablam! is saved as an absolute file. To fix the program, insert the 8K (or greater) expander, turn on your VIC, enter the POKE and SYS from the instructions to move memory up (**POKE 642,32:SYS 58232**), and load MLX. LIST 763 and change the third POKE (**POKE782,1**) to **POKE782,0**. Next, run MLX. Use SHIFT-L to load the Kablam! program. Now use SHIFT-S to save back to tape. You don't need to make any corrections other than the change in line 763 of MLX.

• The Commodore 1600 VICmodem, the 1650 Automodem, and the Telelearning and Westridge modems work with the original "C/G Term" terminal program (November 1984). But the Mitey Mo and HESmodem II have a slightly different method of interfacing with the user port.

The following POKEs will modify C/G Term to make it compatible with the Mitey Mo and HESmodem II.

1. Enter the POKE and SYS from page 48 of the November issue.

2. LOAD "CGTERM",8,1. After it's loaded, type NEW.

3. Type in the following POKEs in immediate mode (without line numbers).

```
POKE 4673,169:POKE 4674,2:POKE 4675,162
POKE 4676,2:POKE 4677,160:POKE 4678,255
POKE 4679,32:POKE 4680,186:POKE 4681,255
POKE 4682,169:POKE 4683,1:POKE 4684,162
POKE 4685,147:POKE 4686,160:POKE 4687,2
POKE 4688,32:POKE 4689,189:POKE 4690,255
POKE 4691,32:POKE 4692,192:POKE 4693,255
POKE 4694,169:POKE 4695,102:POKE 4696,141
POKE 4697,3:POKE 4698,221:POKE 4699,169
POKE 4700,2:POKE 4701,141:POKE 4702,1
POKE 4703,221:POKE 4704,76:POKE 4705,106
POKE 4706,18
```

For the VIC version of C/G Term, make these substitutions in the list:

```
POKE 4697,18:POKE 4698,145
POKE 4702,16:POKE 4703,145
```

4. When you're finished typing, to be sure you've made the correct POKEs, check each location by PEEKing its contents to the screen:

```
FOR X=4673 TO 4706:PRINT X;PEEK(X);:NEXT
```

5. Load and run MLX, give it the starting and ending address from page 48, and use SHIFT-S to save the modified version.

These POKEs set the modem to originate mode, which you should use to communicate with the C/G BBS. When you use C/G Term to communicate with a friend who also has C/G Term and a Mitey Mo modem, one of you will have to set your modem for answer mode. To do this, load the modified version of C/G Term and **POKE 4700,64** before you run the program.

• "Address File" (February) contains a bug. When using the Display option to search for specific last names, the program stops searching when it finds a match. If two or more different records contain the same last name, the first record is displayed, but not the others. The following changes will fix the bug:

```
130 GOSUB660:FORI=1TON:IFB$=M$(I,1)+", "+
    M$(I,2)THEN150                    :rem 65
140 NEXTI:PRINT"{CLR}{DOWN}"B$Q$"{DOWN}IS
     NOT IN FILE.":GOSUB620:GOTO40
                                      :rem 151
300 IFM$(A,1)+M$(A,2)<=M$(A+G,1)+M$(A+G,2
    )THEN350                          :rem 30
410 GOSUB660:FORI=1TON:IFB$=M$(I,1)+", "+
    M$(I,2)THEN440                    :rem 68
660 PRINT"{CLR}{DOWN}{3 RIGHT}WHAT NAME D
    O YOU"Q$"{3 RIGHT}WANT (LAST NAME)":I
    NPUT"{2 DOWN}";B$                 :rem 14
670 PRINT"{DOWN}{3 RIGHT}ENTER FIRST NAME
    ":INPUT"{2 DOWN}";C$:B$=B$+", "+C$:RE
    TURN                              :rem 89
```

• If "Turtle Graphics Interpreter" (October 1984) seems to have trouble interpreting commands, check line 5050 of program 1; there must be a space between the two quotation marks.

Tape users may have discovered that while Turtle Graphics Interpreter works, it does not allow you to save defined procedures to tape. Reader Mark Smitka suggests these corrections:

```
23018 POKE 53274,240
23019 OPEN 2,1,0,WD$+".TURTLE"
23060 CLOSE 2:SYS 49322:RETURN
24018 POKE 53274,240
24019 OPEN 2,1,1,WD$ +".TURTLE"
24040 CLOSE 2:SYS 49322:RETURN
```

After making these changes, when you save or load a procedure, the prompt PRESS PLAY ON TAPE may be unreadable, but this does not affect the program's operation.

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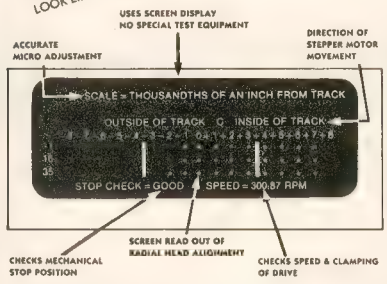

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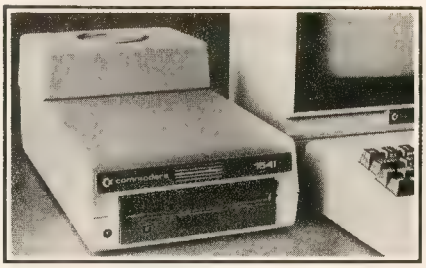

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Triple 64

Feeman Ng

Three computers in your 64? This seven-line program creates three independent 12K blocks which can be accessed very simply. An excellent tool for program development and comparison.

Have you ever wished you could work on two or three programs at once and compare them? Or view a disk directory without erasing a program in memory? This short machine language program lets you do just that.

"Triple 64" is a machine language program (in the form of a BASIC loader) which divides the 64's memory into three independent 12K workspaces. You can work in any of the areas without disturbing the others. You can even save and load from any of the three work areas without affecting the others. The program starts at 40004 ($9C44) and uses only 71 bytes. Also, a favorite area of many machine language programmers, 49152 ($C000), is unaffected.

Accessing Three Computers

After entering and saving Triple 64, type RUN. To access any of the three areas, type SYS 40004. Notice that the cursor disappears immediately after you press RETURN. Now, press 1, 2, or 3, the identification numbers of the three independent work areas, and you're ready to begin programming. If you've found that you don't recall which area you're in, type PRINT PEEK(40061). This will return a 1, 2, or 3.

Techniques And Applications

The most obvious use of Triple 64 is to partition the computer to hold three BASIC programs. These could be games, utilities, or applications—or any combination. And switching between them involves only a SYS and a single keypress. Each work area holds up to 12K, space enough for a fairly sophisticated program. (BASIC programs in the GAZETTE are rarely more than 5K.)

Triple 64 may prove even more useful, however, in the development of your own programs. Since the three workspaces are truly separate, this means, for example, one of them could hold a working version of your program, another might contain a test version you're enhancing, and the third section could provide a scratchpad area where you can try out new ideas and write short programs to test them. These testing routines could even examine the other two memory areas for the effects on the programs residing there. When you've got something working well, you can transfer it to another area with this simple procedure:

1. List it to the screen.
2. Select the desired Triple 64 workspace.
3. Cursor up to the lines you want to transfer, and press RETURN over each of them. They'll immediately be inserted into the BASIC program in the new workspace.

Triple 64 offers a wide range of possibilities—it's almost like having three instant 12K disk drives at your disposal. And if you have a disk drive as well, you can maintain its directory in one workspace while you work in the others. This is very useful if your programs will be using files on the disk currently in your drive.

Triple 64

```
10 FORY=40004TO40071:READA:POKEY,A:NEXT
                                    :rem 180
20 FORY=14336TO14338:POKEY,0:NEXT :rem 29
30 FORY=26624TO26626:POKEY,0:NEXT:NEW
                                    :rem 72
40 DATA174,125,156,165,45,157,129,156,165
   ,46,157,132,156,32,228,255,41,15,240
                                    :rem 19
50 DATA249,201,4,176,245,170,142,125,156,
   189,125,156,133,44,189,126,156,133,56
                                    :rem 71
60 DATA189,129,156,133,45,133,47,133,49,1
   89,132,156,133,46,133,48,133,50,96,1
                                    :rem 24
70 DATA8,56,104,152,3,3,3,8,56,104
                                  :rem 174
```

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The *1541 FLASH!* even adds 21 extra commands for the Commodore 64 user. Some of these include editing, programming and loading commands, as well as "DOS Wedge" commands. You can ignore all these commands, though, and just enjoy the rapid disk operations.

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Michael S. Tomczyk

Putting Computer Math To Work For You

The past two columns have been a "beginner's introduction" to computer math. We've seen that your computer has built-in math functions, and we've also seen how numeric variables (X, AB, etc.) are used in BASIC programs. But with all this built-in math power, many beginners still have trouble writing problem-solving programs in BASIC—so that's what we'll cover in the final lesson about math.

These programs will work on your Commodore 64, VIC-20, Plus/4, and 16. Before we get started, let's review computer math symbols.

+	for addition (PRINT 4+4)
−	for subtraction (PRINT 9−5)
*	for multiplication (PRINT 2*5)
/	for division (PRINT 10/5)
/	for fractions (PRINT 1/2*1/3)
↑	for exponents (PRINT 2↑2)
.	for percent (.12) or decimal (.99)
()	for formulas (PRINT (2/5)*(12.5))—always use same number of left and right parentheses

Math Practice For Parents

A lot of people, especially parents and teachers, like to write math practice programs for children, so let's start with an example to get you started. First, we have to decide a few things. What kind of math do we want to practice? Addition, subtraction, multiplication, division, or a combination of all four? What range of numbers do we want to use in our examples? And do we want to use specific examples or random numbers?

In our example, we'll use addition and use only problems with numbers from 1 to 9. We'll look at a shorter program in a moment, but for now, enter this program and study the techniques being used. And don't forget, you can tailor this program in many ways—for example, print some graphics designs or pictures in different colors, or insert a sound effect when the child gets the answer right.

```
10 Y=1
20 FOR X=1 TO 9
30 PRINT "{CLR}{BLK} THE ADDING GAME": FO
   R SP=1 TO 5: PRINT: NEXT
40 PRINT "WHAT IS"X"+"Y: INPUT A
50 IF A=(X+Y) GOTO 70
60 PRINT "{CLR}{3 DOWN}WRONG...TRY AGAIN"
   : FOR T=1 TO 700: NEXT: GOTO 30
70 IF A=(X+Y) THEN PRINT " {CLR}{3 DOWN}R
   IGHT!": FOR T=1 TO 700: NEXT
80 IF Y=9 THEN GOTO10
90 NEXT
100 Y=Y+1: GOTO20
```

Type RUN and press RETURN to use the program. To exit the program after you've got it running, hold down the RUN/STOP key and press RESTORE (RUN/STOP–RESET on the Plus/4 and 16). This program is actually a bit more cumbersome than it has to be, so we can show you some computer math and programming techniques. Let's look at the commands.

Line 10 defines the variable Y as 1. Now the variable Y is the same as the number 1—until we redefine Y in line 100.

Line 20 is the beginning of a very long FOR-NEXT loop. Everything between the FOR in line 20 and the NEXT in line 90 will be repeated 9 times. The FOR-NEXT loop keeps track of each repetition by increasing the value of X on each loop. Because of this, the value of X is 1 the first time the program runs through. The next time the program runs through the loop, the value of X becomes 2, then 3, 4, and so on up to 9. We can use the value of X in other places in our program—our X is defined by the FOR-NEXT loop which is "keeping track" of which loop it's on,

but X still represents a number and we can use it elsewhere.

Line 30 clears the screen and sets the color to black, then displays the opening message. The FOR-NEXT loop in this line is used to print five blank lines (the PRINT command by itself puts a blank line on the screen). This positions the next message farther down the screen.

Line 40 asks our math question. First we print the words WHAT IS inside quotation marks. Then we go outside quotes to print the value of X (which is 1 on the first loop). Then inside quotes to print the plus sign, then back to outside quotes to print the value of the variable Y (which we defined as 1 in line 10). Finally, we ask for an INPUT which automatically displays a question mark on the screen and waits for the child to type in a number and press RETURN. The variable A (for Answer) represents the child's number. From now on, the variable A is the same as the number the child types in.

Line 50 is an IF-THEN statement. IF A = (X+Y) means literally "If A equals the sum of X plus Y." If, in fact, A equals X+Y, then we go to line 70. If not, continue with line 60 where we clear the screen, cursor down three times, and print the WRONG message. The FOR-NEXT loop in this line is a "time delay" loop. You can increase or decrease the delay by changing the number 700. Finally, if there is a wrong answer, the computer goes back to line 30 and repeats the question using the same values of X and Y. The program keeps looping back and will not go on until the child gets the answer right. This is one reason computers are said to be "infinitely patient" teachers.

Line 70 is similar to line 50. If the answer A equals the sum of X+Y, then we clear the screen, print the RIGHT message, pause for a time delay of 700 and automatically move on to line 80.

Line 80 checks to see if Y equals 9, which signals the end of the math sequences. If Y equals 9, the computer goes back to line 10 and resets the value of Y to 1, but line 80 *does not change* the value of Y (that happens in line 100).

Line 90 contains the NEXT command from the FOR-NEXT loop we began in line 20. This command stops the computer here after each loop, sends it back to line 20, and increases the value of X by 1. Remember, Y still equals 1. Thus, in the second loop, the X+Y in our math problem becomes 2+1. In the third loop, X+Y becomes 3+1, and so on. When X equals 9, the computer completes the loop (FORX=1TO9) and, at that point, instead of looping back, *continues on* to line 100.

Line 100 increases the value of Y by 1 and goes back to line 20. Now Y=2 and X=1. We repeat the FOR-NEXT loop so X+Y in our math problem becomes 1+2, 2+2, 3+2, etc., as X changes from 1 to 9 and Y stays at 2. When X equals 9, the program drops out of the loop to line 100, increases Y to 3, and loops through the math problems (1+3, 2+3, 3+3, etc.). This pattern continues until both X and Y equal 9. At that point, the IF—THEN statement in line 80 takes effect and resets the whole program. If this is still a bit confusing, here's a short program that demonstrates how a FOR-NEXT loop changes the value of the "loop variable" M on each pass through the loop. Watch to see at which point the program leaves the loop and continues on to print the message in line 50:

```
10 PRINT"{CLR}":FOR M=1 TO 5
20 PRINT "LOOP NUMBER" M
30 PRINT "THE VALUE OF M IS" M
40 NEXT
50 PRINT"AT THE END OF THE LOOP THE PROGR
   AM CONTINUES..."
```

Random Numbers

You can make the computer generate the values of X and Y completely at random—which is probably a good idea if your child figures out that most of the questions in the previous example can be answered simply by counting in order. Here's what the same program looks like with random numbers:

```
5 X=INT(RND(1)*9)+1
10 Y=INT(RND(1)*9)+1
20 PRINT "{CLR}{BLK} THE ADDING GAME": FO
   R SP=1 TO 5: PRINT: NEXT
30 PRINT "WHAT IS"X"+"Y: INPUT A
40 IF A=(X+Y) GOTO 60
50 PRINT"{CLR}{3 DOWN}WRONG...TRY AGAIN":
    FOR T=1 TO 700: NEXT: GOTO 20
60 IF A=(X+Y) THEN PRINT"{CLR}{3 DOWN}RIG
   HT!": FOR T=1 TO 700: NEXT
70 GOTO 5
```

As you can see, it's actually easier to use random numbers than to try to put everything in order! Lines 5 and 10 use a random number formula (see below) to define X and then Y as a random number from 1 to 9. To get new random numbers for X and Y, all we have to do is go back to lines 5 and 10 and new numbers are automatically selected. The rest of the program is the same as our previous example except that at the end of the program all we have to do is go back to the beginning.

A Quick Review

If you're not sure what a random number is, try this little exercise: Take 10 pieces of paper, write the numbers 1 to 10 on each piece, and put them

in a hat. Now pick up one number without looking. You've just selected a random number from a range of 10 numbers. The lower limit of the range is 1 and the upper limit is 10. Now put the number you drew back in the hat and draw again. Keep drawing as long as you like, but make sure all the numbers are always put back in the hat before you draw. Your hat has now become a "random number generator."

The computer can generate random numbers, too—but much faster. Instead of storing numbers in a hat, the computer stores the numbers in its memory. To use the computer to choose random numbers, you need a random number formula.

In the following formula, we'll define variable R as a random number. To do this, you have to know the lower limit, the upper limit, and the range of numbers you want the computer to choose from:

R = INT(RND(1)*range) + lower limit

Let's tell the computer to choose a random number from 6 to 10, including the 6 and the 10. In this example, the *lower limit* is 6, the *upper limit* is 10, and the *range* is 5. *To determine the range, subtract the lower limit from the upper limit, and add 1.* If the *lower limit* is 6 and the *upper limit* is 10, the *range* is 5 because (10 − 6) + 1 = 5. You can also see that if you count 6, 7, 8, 9, 10, you have 5 numbers, so the range of numbers we're choosing from is 5. See how it works? To use the formula, just plug in the lower limit and the range like this:

R = INT(RND(1)*5) + 6

Now you have to decide what to do with your random numbers—print them, use them in a formula, a game, or what? Let's try something a trifle out of the ordinary. Type NEW and press RETURN, then enter this program:

```
10 G=INT(RND(1)*3)+105
20 PRINT CHR$(G);
30 GOTO 10
```

Type RUN and press RETURN. Your screen begins to fill up with graphics. If you look closely, you'll see that only three symbols are being used—but they are being selected and displayed by the computer in a random pattern.

Line 10 defines G as a random number selected from these three numbers: 105, 106, and 107. Line 20 displays the symbol represented by the CHR$ code. In this line, we're using the random number to represent a CHR$ code. Each symbol and command on your keyboard has its own CHR$ code, sometimes called an ASCII value. (CHR$ codes are listed in the back of your user's manual.) Printing the CHR$ code is the same as printing the symbol itself. Here, we've selected three CHR$ codes (105, 106, and 107) and we're printing them at random on the screen to make a pattern. The semicolon in line 20 causes the symbols to appear next to each other. Line 30 tells the computer to go back to line 10 and choose another random number before printing the next CHR$ symbol. Press RUN/STOP to stop the program.

Guessing Game

This program is one of the most classic computer math games. It may even be the first computer game. The object is to guess a number from 1 to 10—but the game isn't nearly as important as the concepts we're going to learn. We'll see how random numbers are used—we'll use the "greater than" (>) and "less than" (<) symbols, the "not equal to" (<>) sign, and, of course, variables. Type NEW and press RETURN, then enter this program and run it:

```
10 R=INT((RND(1)*10)+1):C=0:PRINT CHR$(14
   7);
20 C=C+1: PRINT "{2 DOWN}GUESS NUMBER" C
40 PRINT "{DOWN}GUESS A NUMBER{8 SPACES}F
   ROM 1 TO 10": INPUT N
50 IF N=R THEN PRINT "RIGHT!": FOR T=1 TO
    1000: NEXT: GOTO 10
60 IF N<>R THEN PRINT "WRONG...TRY AGAIN"
   : FOR T=1 TO 1000: NEXT: GOTO 20
```

The computer chooses a random number from 1 to 10. You have to guess the number. The computer tells you whether you're right or wrong, then either asks you to choose again or selects another number. The computer also keeps track of how many guesses you've made.

Line 10 defines the variable R as a random number between 1 and 10, sets the value of C (our "guess counter") to zero, and clears the screen (PRINT CHR$(147) is the same as clearing the screen).

Line 20 uses a simple counter (C=C+1) to keep track of how many guesses have been made, then prints the number of the "guess." Every time there's a wrong answer, the program loops back to this line and increases the value of C by 1, which "counts" the number of guesses.

Line 40 cursors down a line, prints the message, and waits for a number (N) to be typed in.

Line 50 is similar to the RIGHT messages in our math practice example. It checks to see if the INPUT number (N) equals the random number (R), then goes back to get a new random number if the answer is right.

Line 60 contains the WRONG message. If N does not equal (<>) R, it prints the message, waits for a time delay of 1 to 1000, then goes back to line 20 to increase the "C counter" and repeat the guessing message.

A Business Math Lesson

You can use computer math to solve a wide variety of business problems. Here's a quick example to show you how it works. Let's say we're going into business to manufacture a new kind of flower vase. The vases are made out of pottery and are designed with computer symbols. The vases will be sold through computer stores as a novelty item.

It will cost us $3 to produce each vase, plus about 75 cents for a shipping carton and postage. So our *unit cost* is $3.75.

Most vases currently sell for $12.95, but we're going to sell ours for a *retail price* of $8.

Typically, a computer store gets a 30–40 percent *discount* off the retail price. Our discount will be 40 percent.

The *wholesale price* is the price that we charge the computer stores who buy our vases. In this case, the wholesale price is the retail price ($8) multiplied by the discount (.40).

Gross margin is the profit we earn before subtracting production and selling costs. This is calculated by subtracting the *cost* from the wholesale price. You can express gross margin either as a dollar figure or a percentage.

The *gross margin percent* is calculated by dividing the gross margin into the cost.

Our challenge is to write a computer program that answers these questions:

1. What wholesale price should we charge our dealers?
2. What is the gross margin in dollars on each vase we sell?
3. What percent of our cost does our gross margin represent?
4. What are the total sales projected in dollars?
5. What is the total gross margin in dollars?

Here's a BASIC program that answers these questions:

```
10 PRINT CHR$(147) "ENTER UNIT COST";:INP
   UT C
20 PRINT "ENTER RETAIL PRICE": INPUTR
30 PRINT "ENTER DISCOUNT %":INPUT D
35 IF D>1 THEN D=D*.01
40 W=(R-R*D)
45 PRINT "ENTER TOTAL UNITS YOU EXPECT TO
    SELL DURING PERIOD"
46 INPUTU
50 PRINT CHR$(147) "1. RETAIL PRICE.....
   {5 SPACES}$" R
55 PRINT "2. WHOLESALE PRICE..{5 SPACES}$
   " W
60 PRINT "3. COST PER UNIT....{5 SPACES}$
   " C
65 PRINT "4. GROSS MARGIN.....{5 SPACES}$
   " (W-C)
70 PRINT "5. GROSS MARGIN AS A"
75 PRINT "{3 SPACES}PERCENT OF COST
   {7 SPACES}$" (W-C)/C
80 PRINT "6. SALES (UNITS)....{4 SPACES}"
    U
85 PRINT "7. SALES (DOLLARS)..{5 SPACES}$
   " (U*W)
90 PRINT "8. GROSS MARGIN ON"
95 PRINT "{3 SPACES}TOTAL SALES.....
   {5 SPACES}$" (U*(W-C))
105 PRINT "{DOWN}{3 RIGHT}PRESS ANY KEY
    {9 SPACES}TO START OVER"
110 GET K$: IF K$="" THEN GOTO 110
115 GOTO 10
```

Line 10 uses PRINT CHR$(147) to clear the screen, then prints a message and asks for an INPUT. We used the variable C to stand for Cost, which in our example is $3. From now on the variable C is the same as the cost number that was typed in.

Lines 20 and 30 print messages and ask for additional INPUTs. The retail price is $8 and the discount should be .40 (.40 is the same as 40 percent.)

Line 35 is helpful to the user. It corrects the answer (input) if the user makes a mistake typing the discount percent. The IF-THEN statement checks to see if D is greater than (>) 1. If the user's answer to the INPUT in line 30 includes the decimal point (.4 or .40), then D is less than 1 and the computer moves on to line 40. If, however, the user typed 40 in response to line 30, the computer sees that 40 is greater than 1 and automatically converts D to the proper form by multiplying D times .01. In other words, if D was 40, the program redefines D as (40*.01) which is .40—the same as 40 percent.

Line 40 calculates the wholesale price by taking 40 percent of the retail price and then subtracting it from the retail price. You could also find the wholesale price by using this formula: R*(1−D), which is the same as .60 times the retail price. From now on we'll use W for Wholesale price. The answer, incidentally, is $4.80.

Line 45 asks for the estimated number of units you expect to sell. Don't forget that commas are never used in computer math. So if you expect to sell 3,000 units, the INPUT should be typed in as 3000 without the comma.

Line 50 clears the screen and prints the retail price (which you typed in earlier).

Line 55 displays the wholesale price we calculated in line 40.

Line 60 displays the unit cost.

Line 65 calculates and displays the gross margin, which is obtained by subtracting the cost (C) from the wholesale price (W).

Line 70 is the first part of a PRINT message which we want to appear on two lines so it aligns properly on the screen.

Line 75 completes the PRINT message and

calculates the gross margin percent, which is obtained by subtracting cost from wholesale price and dividing it by cost.

Line 80 displays sales in units (actually a sales forecast).

Line 85 calculates and displays sales in dollars, which is obtained by multiplying the total units times the wholesale price. Remember, if you're a manufacturer, your sales are based on the wholesale price you receive from dealers. The computer store dealers' sales are calculated from the retail price, but the manufacturer uses the wholesale price.

Lines 90–95 calculate and display the gross margin on total unit sales, which is obtained by multiplying the total projected units times the gross margin.

Lines 105–115 set up the PRESS ANY KEY option. The PRESS ANY KEY message is printed in line 105. Line 110 is a standard GET K$ line which is used to scan the keyboard. It makes the computer wait until a key is pressed before going on. Line 115 goes back to line 10, clears the screen, and starts the program over from scratch.

Using Parentheses

You may be wondering why we used the parentheses () the way we did in our business example, so here's a quick explanation. The answer to the following calculation is 7, but how does the computer get the answer?

```
PRINT 3+2*6/3
```

The computer always scans the calculation from *left to right* and first does the *multiplication and division.* Then it goes back and performs *addition and subtraction.* The following chart shows how the computer solves the calculation step-by-step.

What The Computer Does	Result After Each Step
Computer scans calculation.	PRINT 3+2*6/3
Multiply 2*6, which is 12.	PRINT 3+12/3
Divide 12 by 3, which is 4.	PRINT 3+4
Add 3 to 4, which is 7.	PRINT 7

Remember, the computer *multiplies and divides first,* starting from *left to right*—then it *adds and subtracts.* You can control the order of calculation by using parentheses ().

Parentheses tell the computer exactly which parts of the calculation to perform first. Type the following program:

```
10 PRINT 3+2*6/3
20 PRINT (3+2)*(6/3)
30 PRINT (3+(2*6))/3
```

When you run this program, you get three different answers because the parentheses told the computer an order in which to perform the calculations. Here's how:

Line 10 is the example we looked at first.

In line 20, the computer first performs the calculations inside the parentheses by adding 3+2 to get 5—and dividing 6 by 3 to get 2. After this, the formula looks like this to the computer: (5)*(2), so now the computer multiplies 5 times 2 and prints the answer, which is 10.

Line 30 looks complicated, but it really isn't if you understand how the parentheses work. We start by finding the left and right parentheses which are closest together. This is where the computer starts calculating. The parentheses which are *closest together* are (2*6), so first the computer multiplies 2*6 to get 12. Now the calculation looks like this to the computer: (3+(12))/3.

Next we plug the 12 into the formula and work our way out to the next set of parentheses, which looks like this: (3+(12)). The computer adds 3 to 12, which is 15, so now this part of the formula looks like this: ((15))/3—and 15 divided by 3 is 5 so the computer prints the answer, which is 5.

The two right parentheses may look a little strange but we need them because in computer calculations you always need the same number of left and right parentheses. This is essential. If you don't balance parentheses, the computer will give you a SYNTAX ERROR.

Fractions And Computer Math

You can also use parentheses in computer math to convert fractions. For example, the fraction 1/4 is really .25. Here's a quick way to see the decimal equivalents to the fractions from 1/1 to 1/16:

```
FOR F=1 TO 16: PRINT "1/" F " EQUALS" 1/F:
NEXT
```

The computer gives you the answer in decimals, which is another way of expressing fractions. But how do you express a number like 4-1/2? Easy. The number 4-1/2 is the same as adding the number 4 and the fraction 1/2, so if you need to insert a number like 4-1/2 in a computer math formula, you can add the four and the 1/2 inside parentheses, like this:

```
PRINT (4+1/2)
PRINT (4+1/2)*(3+1/3)
```

There are many other ways to use parentheses, particularly in long business or scientific formulas. We'll be exploring some of these techniques as we go along, but for now we'll give "computer math" a rest and spend the next few months exploring other aspects of BASIC programming. Next month, we'll take a look at a group of commands which are seldom discussed in detail—the string ($) functions.

Richard Mansfield, Senior Editor

Customizing BASIC

"Wedge," our example program this month, has several uses. It will show you the number of bytes free in your memory, but unlike typing ?FRE(1), it's always on the screen while you program. Thus, you can see the effect of adding a single line, of a DIM statement, or any other changes you might make to a program.

While people with an unexpanded VIC are likely to find this constant memory report of the most value, others will also benefit from the way that it reveals how memory is used in a BASIC program. What's more, Wedge illustrates how you can wedge a machine language program into your BASIC language. This is a way that the DOS Wedge and other BASIC expansion utilites can make themselves part of BASIC itself.

(If you don't have an assembler, you can just type in Program 2 and run it like a normal BASIC program. It will build the ML wedge routine for you automatically. Then just SYS 828 to activate Wedge. And, if you're using a Datassette, be sure to disable Wedge by pressing RUN/STOP–RESTORE before tape saves or loads.)

Using Words Instead Of Numbers

Let's go through Program 1 to see how a wedge works. First, you'll see a series of definitions between lines 40–110. Here we tell the assembler the meaning of the various words (called *labels)* that we'll be using in the program. These labels refer to routines or locations within BASIC itself which we will need to access to make our wedge program work.

You can find the addresses of such routines in memory maps for your VIC or 64. Perhaps the most complete and understandable maps are found in *Mapping the 64* and *Mapping the VIC* (COMPUTE! Books). When you need to do something like print a character to the screen, you'll need a map to tell you that address $FFD2 (65490 decimal) will print the character in the Accumulator. This, and hundreds of other subroutines, are waiting inside your computer. All you need to know is their address (and what information they want from you before you call on them with a JSR).

Because of a kink in the way ?FRE(1) works, because it doesn't really print the actual number of bytes free, we'll avoid using the ?FRE() routine in ROM. Let's create our own routine which displays the actual number. However, to do this, it's worth looking at the way BASIC calculates bytes free. I used a disassembler to study what BASIC does when you type ?FRE. Again, I got the address from a map.

How BASIC Stores Programs

It turns out that the computer simply subtracts the address of the arrays from the address of the strings. What's left over is "free" for you to use. To understand what this means, we need to briefly outline how BASIC stores its programs in RAM. First (lowest in available RAM memory) it puts the program itself with the line numbers, commands, and embedded strings (strings like A$ = "BETTY"). All this is held together in one mass, and it builds upward as you add new lines to a program.

Above that, there is a storage area for simple numeric variables. Next, any arrays. Then there is a section of free RAM which is the total number of bytes not yet used by either the program proper, the variables, the arrays, or the strings. Finally, *building down from the top of available RAM*, dynamic strings are stored—*dynamic* means they change during a program RUN, like A$ = A$ + B$. So the space between the top of the arrays and the bottom of the strings is the free RAM.

Addresses 51,52 in your computer always contain a two-byte number which tells you exactly where the bottom of your string storage is

Program 1: Wedge

```
10 *= 828
11 ;                                "WEDGE"
12 ;
13 .S
14 .O
40 ;  ------------ DEFINITIONS -------------
50 ;
60 STRINGMEMORY = 51;      POINTER TO BOTTOM OF STRINGS
70 ARRAYMEMORY = 49;       POINTER TO TOP OF ARRAYS
80 CHARS = 48589;       CHANGE INTEGER INTO PRINTABLE CHARACTERS
81 ; (USE 56781 FOR VIC CHARS ADDRESS)
90 PLOT = 65520;           SET LOCATION OF CURSOR
100 MAINLOOP = 770;        ADDRESS OF BASIC'S ENTRANCE TO ITS MAIN LOOP
105 PRINT = $FFD2;          PRINT CHARACTER IN THE ACCUMULATOR
110 ;
120 ;  ------------ RESET POINTER -------------
130 ;
140 LDA #<ROUTINE:STA MAINLOOP:LDA #>ROUTINE:STA MAINLOOP+1:RTS
150 ;         THIS POINTS BASIC TO OUR SPECIAL WEDGE.
160 ;
170 ;  ------------------------ THE WEDGE -----------------
180 ;
190 ROUTINE STA A:STY Y:STX X:PHP;  SAVE STATUS OF THE REGISTERS
200 SEC:JSR PLOT;                   FIND CURRENT CURSOR POSITION
210 STX PX:STY PY;                  SAVE CURRENT CURSOR POSITION
220 LDY #0:LDX #30:CLC:JSR PLOT;    SET UP A NEW CURSOR POSITION
230 LDA #58:JSR PRINT;              PRINT A COLON ON SCREEN
240 ;
250 SEC:LDA STRINGMEMORY:SBC ARRAYMEMORY:TAX
260 LDA STRINGMEMORY+1:SBC ARRAYMEMORY+1
270 JSR CHARS;                                  CHANGE TO PRINTABLE CHARS.
280 ;                                           AND PRINT THEM ON SCREEN
290 ;
300 ;  ------------ RESTORE CURSOR POSITION AND REGISTERS --------
310 ;
320 LDX PX:LDY PY:CLC:JSR PLOT;       RESTORE CURSOR POSITION
330 PLP:LDX X:LDY Y:LDA A;            RESTORE REGISTERS
340 JMP 42115;                        GO BACK INTO BASIC'S MAIN LOOP
341 ; (USE 50307 FOR VIC TO GO BACK INTO BASIC'S MAIN LOOP)
350 ;
360 ;  --------------------- VARIABLES ----------------------
370 ;
380 A .BYTE 0
390 Y .BYTE 0
400 X .BYTE 0
410 PY .BYTE 0
420 PX .BYTE 0
430 .END WEDGE
```

located. Likewise, addresses 49,50 tell you where the top of your arrays is.

Important Addresses

Another interesting definition can be found in line 80 of Program 1. This routine is normally used by BASIC to print out line numbers. It's a convenient way to transform the computer's ML-style integer number storage format into human-readable decimal numbers on screen. This is handy for printing game scores on screen, etc.

The computer stores most numbers (including the addresses of string storage, etc., mentioned above) in a two-byte format. The higher byte (address 52, for string storage) is multiplied by 256 and then added to the lower byte (address 51).

To display such a number on screen at the current cursor position, you would LDX with the lower byte, LDA with the higher byte, and JSR 48589 (56781 for VIC). Play around with this a bit. LDA #0: LDX #45: JSR 48589 will print 45 on screen. What would happen if you LDA #1 in this example? Also, try printing out the string

Program 2: Free 64

```
10 REM 64 WEDGE LOADER
800 FOR ADRES=828TO907:READ DATTA
810 POKE ADRES,DATTA:NEXT ADRES
828 DATA 169, 71, 141, 2, 3, 169
834 DATA 3, 141, 3, 3, 96, 141
840 DATA 140, 3, 140, 141, 3, 142
846 DATA 142, 3, 8, 56, 32, 240
852 DATA 255, 142, 144, 3, 140, 143
858 DATA 3, 160, 0, 162, 30, 24
864 DATA 32, 240, 255, 169, 58, 32
870 DATA 210, 255, 56, 165, 51, 229
876 DATA 49, 170, 165, 52, 229, 50
882 DATA 32, 205, 189, 174, 144, 3
888 DATA 172, 143, 3, 24, 32, 240
894 DATA 255, 40, 174, 142, 3, 172
900 DATA 141, 3, 173, 140, 3, 76
906 DATA 131, 164
```

Program 3: Free VIC (substitute these lines in Program 2)

```
882 DATA 32, 205, 221, 174, 144, 3
906 DATA 131, 196
```

storage address. You do it the same way, but LDX 51:LDA 52 (not using the number sign means Load from the *address* indicated, instead of loading the *actual number itself*). If you don't own an assembler, you can see how this routine works from BASIC. POKE the high byte into 780, the low byte into 781, and SYS 48589 (56781 on a VIC).

We'll define the meaning of PLOT and MAINLOOP when we describe how the Wedge program works. First, however, let's see how to initialize a wedge.

Inserting The Wedge

Sure, BASIC is built into the computer. It's huge. It's entirely ML. It allows you to write programs. But *BASIC is, itself, a program.* Like any other program, it uses data (whatever program *you* type in is the data); it has subroutines (like the CHARS subroutine we discussed above); and it has a main loop. There is a delicate place in BASIC, a soft spot. It spends most of its time just looping through this main loop, waiting for you to type something in. It's here we can attach ourselves to the main loop. We can make BASIC think that our Wedge is one of its normal, required jobs.

One thing that makes our task easier is that BASIC vectors (jumps) through address 770 as part of its main loop. Normally (when you turn on power to the computer) that address will send BASIC right back where it came from in ROM. However, if we change the two-byte number at 770,771 to point to our own ML routine, then our routine, our wedge, will effectively become part of BASIC's main loop and will be active until power is turned off. We must, however, end our new ML routine with a jump back to the normal BASIC loop in ROM (see line 340).

So, the first thing that happens when we SYS 828 and activate the wedge is that we replace the address of the normal BASIC main loop with the address of our ML routine in that soft spot, addresses 770,771. We've already given 770 the label MAINLOOP (line 100), so in line 140 we can LDA #<ROUTINE:STA MAINLOOP. That puts the low byte of the address of our routine into the low byte of the soft spot. (We labeled the start of our wedge with the name ROUTINE by simply calling it ROUTINE in line 190—that's all you need to do to give some subroutine a name, just type in the name at the start of the subroutine. From then on, you don't need to specify any particular address, just use the name itself.)

Anyway, the special assembler instruction #< will extract the low byte of a number. In this case, we're using the label ROUTINE which is the true start of our wedge. Whatever its low byte is will be put into address 770. Then, we do the same thing for the high byte with the #> command and put it into MAINLOOP+1 (which is address 771). You can see that we don't need to bother knowing where in memory ROUTINE will be. We can extract and store its address using the #< and #> pseudo-ops. (A *pseudo-op* is an instruction which tells an assembler how to do something. It's not one of the 6502 computer-understandable commands. It doesn't become part of the final ML program. It just assists you by communicating some special information to your assembler.)

Now that we've linked ourselves into BASIC's main loop by stuffing our ROUTINE address into that special MAINLOOP vector, whatever follows will be continually executed by the computer.

Keeping BASIC Sane

We don't want to muck things up for BASIC, though. So our first responsibility is to save the current values held in the Accumulator, the X and Y registers, and the Status Flag. All this is accomplished in line 190. For example, we save the Accumulator value in a variable we've named "A" (see line 380). You could call it whatever you wanted: SAVEACC might be your name for the place where the Accumulator is stored during the active life of the wedge. If you chose that name, line 380 would simply read:

```
380 SAVEACC .BYTE 0
```

and line 190 would say STA SAVEACC.

The assembler doesn't care what names you give things, just so you're consistent. The .BYTE pseudo-op simply reserves space in memory for you to store things. For every number following .BYTE, one byte will be set aside. If you wanted to reserve five bytes for some kind of storage, you would type:

```
STOREFIVE .BYTE 0 0 0 0 0
```

or if you wanted to store particular numbers there ahead of time you could type:

```
FIRSTFIVE .BYTE 0 1 2 3 4
```

Whatever. It's pretty much up to you. You can use these storage places the way you'd use variables in BASIC. You can put things in and get them out by just giving the location label, as in LDA FIRSTFIVE (getting you the 0) or LDA FIRSTFIVE+3 (loading in the 3).

You can store alphabetic characters, too:

```
NAME .BYTE "STEVE (just use the quotes to show that it's alphabetic)
```

Manipulating Cursor Position

But back to the wedge. After we save the registers, we JSR (Jump to SubRoutine) to the PLOT subroutine within BASIC. PLOT is a valuable routine. If you first set the carry flag (in the Status Register, by invoking the SEC command as we're doing here), the PLOT routine does something useful. When the computer returns from JSR, you'll find the X Register holding the current line number and the Y Register the current column where the cursor is. Again, we're going to save the current cursor position (using SEC:JSR PLOT:STX PX:STY PY). PX and PY are BYTE defined variable storage locations (like the A, X, and Y storage).

Next, however, we can make PLOT perform the reverse function by simply using CLC (CLear the Carry flag) instead of SEC . Now (line 220), we've loaded the Y Register with the line number and the X Register with the column number. This JSR to PLOT installs this as the new current position of the cursor on screen. That's where we'll want to position our bytes free report.

We then print a colon to the screen to prevent accidental RETURNs over the bytes free number (thereby possibly affecting the BASIC program).

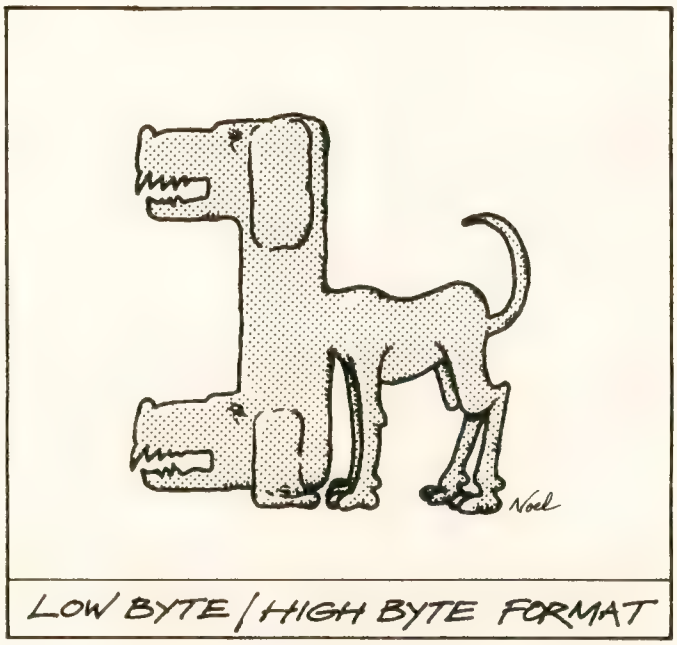
Now (lines 250–260) we subtract the top-of-arrays memory location from the bottom-of-strings and leave the low byte of the result in the X Register and the high byte of the result in the Accumulator. The high byte is already in the Accumulator following the second subtraction (SBC) command.

Tidying Things Up

JSR CHARS prints the number of bytes free on the screen and we're pretty much finished with our wedge. All that's left is a bit of housecleaning: restoring the saved registers and the cursor position to their status before we entered our wedge. So, we LDX from the PX variable, LDY and make PLOT restore the line and column of the cursor. Then, we pull the processor status byte (the flags) off the stack with PLP, restore the values of A, X, and Y, which have been held for us in the variable spaces we created and unimaginatively called A, X, and Y, and then jump into the normal BASIC main loop address.

It's instructive to activate Wedge and then type in BASIC lines and see their impact on memory usage. For one thing, try DIMming different kinds of arrays (integer, floating point, or string) to see how much space each kind reserves for itself. You'll have to run the program to force the DIM into action—just typing in a new BASIC line with DIM in it won't allocate space.

Also try building a sample array from DATA statements. Try CLR, NEW, etc. What would happen if you defined a variable in immediate mode? (A$ + "NEW WORD")? If you want a challenge, see if you can modify Wedge to work while a BASIC program is running, so you can SYS 828 from within the program itself.



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HORIZONS

Charles Brannon
Program Editor

This month, let's take a detailed look at a small game program written in BASIC. We frequently get questions about how to write computer game software, questions like: "How do you move an object around the screen with a joystick?" "How do you tell when one object has hit another?" "How do you get the computer to keep score?"

It's worth remembering that, inside a computer, there are no "objects," just strings of numbers moving around in memory. And it can help a programmer to think of a game as a series of actions, but these actions are expressed in great detail. You cannot just type in MOVE PLAYER1 WITH JOYSTICK. Even a prewritten subroutine cannot be flexible enough to adapt to all possible variations of moving a player with a joystick. You have to read the joystick, interpret the direction, then use statements to move the object (a character or a sprite, say) in the desired direction. While you move the object, you have to move any other objects, check for collisions between objects, update the score, decrease game time remaining, update sound effects, etc. You have to give all the details.

"Pudding Mountain Miner"

This 17-line program is a complete, though tiny game. I originally wrote this program to run with a COMPUTE! subscription promotion in several major newspapers when the GAZETTE first started up. Readers of the ad could enter the small program and get a taste of typing in their own programs. The game is pretty much fun to play, considering its size. Pudding Mountain Miner runs on either the VIC or 64, thanks to some programming that checks to see which machine it's running on. It's tightly packed, written to use as little space as possible. This can make a program hard to read, since long variable names, single statement lines, and REMarks all take their share of space and memory.

```
100 V=(PEEK(0)=76):W=40+18*V:T=1024-6656*
    V:C=55296+16896*V:S=53281+16402*V
                                    :rem 20
110 C$=CHR$(147):PRINTC$:POKES,1-26*V:FOR
    I=0TOW-1:Q=22*W+I               :rem 208
115 POKET+Q,160:POKEC+Q,7:NEXT      :rem 93
120 S$=CHR$(32)+CHR$(158)+CHR$(18)+CHR$(1
    88)+CHR$(146)+CHR$(156)+CHR$(185)
                                    :rem 105
130 S$=S$+CHR$(31)+CHR$(175):Q=RND(1)*(W-
    7)+3+22*W:POKET+Q,164:POKEC+Q,5
                                    :rem 21
140 FORI=0TOW-1:FORJ=0TO7*RND(1)+3:Q=(21-
    J)*W+I:POKET+Q,160:POKEC+Q,2:NEXT:NEX
    T                               :rem 134
150 PRINTCHR$(142);CHR$(19);:Y%=4*RND(1)+
    1:FORI=1TOY%:PRINT:NEXT:X=0     :rem 139
160 L$=CHR$(157):PRINTS$;L$;L$;L$;:X=X+1:
    GETA$:IFA$=""ANDX<W-4THEN160    :rem 67
170 IFX=W-4THENPRINTTAB(X);CHR$(32);CHR$(
    32);CHR$(32);:GOTO150           :rem 202
180 FORI=Y%+2TO22:Q=I*W+X+1:P=PEEK(T+Q)
                                    :rem 102
190 POKET+Q-W,32:POKET+Q,90:POKEC+Q,8*RND
    (1):IFP=32THENNEXT              :rem 193
200 B=B+1:POKET+Q,32:IFI<22GOTO160
                                    :rem 251
210 IFP<>164THENFORI=0TO255:POKEC+Q,I:POK
    ET+Q,I:NEXT:PRINTC$;"YOU LOST":GOTO23
    0                               :rem 74
220 FORI=1TO50:POKET+Q,32+132*F:F=1-F:NEX
    T:PRINTC$;"YOU WON! ";B;"BOMBS"
                                    :rem 61
230 PRINT:PRINT"PRESS "CHR$(18);"RETURN";
    CHR$(146);" TO PLAY{2 SPACES}AGAIN"
                                    :rem 180
240 GETA$:IFA$<>CHR$(13)THEN240     :rem 254
250 RUN                             :rem 140
```

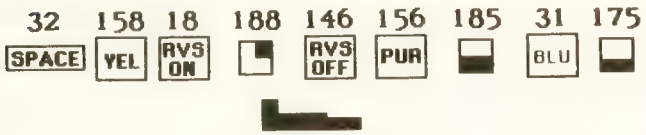
Game Description

When writing a game or analyzing one, it's often best to start at the top and work your way down. You analyze the "big picture" first, then descend into the details. The goal of Pudding Mountain Miner is to get the gold, represented by a dollar sign, by clearing away the mountain of chocolate

pudding. As the airplane flies across the screen, you press the space bar to drop a bomb. The bomb falls and takes out a piece of the mountain. You continue to chip away at the mountain until you expose the gold at the base. You can lose if you blast your way to the base without uncovering any gold. (By the way, originally the mountain was your ordinary kind, made of rock, but some here felt that blasting a mountain to bits was too violent. Hence, "Pudding Mountain.")

Program Overview

The airplane is made of character graphics from the built-in character set.



Exploded Airplane

The computer moves the plane by drawing the airplane, then erasing it, then redrawing it one space forward. This cycle continues, and the plane appears to move across the screen. The mountain is made of solid squares (reverse-video spaces), and is built up column-by-column, by POKEing to the screen.

POKEing to the screen? You may think that you can POKE only to memory. How can you do a POKE that displays a character on the screen? The screen display is represented in the computer by a bank of memory locations. Each character has a numerical value that goes into *screen memory*. The number used is not in ASCII, which you may be familiar with if you've used CHR$ and ASC in BASIC. The numbers used to represent characters are in a special order, the screen code. A complete table of screen codes is given in an appendix in your user's manual. For example, the alphabet ranges from 1–26, instead of 65–90.

The color of each character goes into a parallel area of memory, *color memory*. There are eight colors on the VIC, 16 on the 64, numbered from 0–7 or 0–15. This is the number POKEd into a spot in color memory.

The screen on the VIC is made up of 23 lines of 22 characters. The 64 screen is 25 lines of 40 characters. Multiplying the two figures gives you the total number of characters on the screen, 506 on the VIC, and 1000 on the 64. To get a character on the screen, start with the starting location of screen memory (1024 on the 64, 7680 on the unexpanded VIC), then add in a number from 0–505 (on the VIC) or 0–999 (on the 64) to get the location for where you want the character to go.

If you want to put the letter A on the screen at row 12 and column 20, the POKE would be:

```
POKE 7680+12*22+20,1 (unexpanded VIC)
POKE 1024+12*40+20,1 (64)
```

Note how the row (12) is multiplied by either 22 or 40, the width of the screen. You should also always set the color of the character you POKE onto the screen. Normally, you let PRINT take care of this for you, but when you are directly POKEing to the screen, you have to do all the work yourself. The starting location of color memory on the 64 is 55296, on the unexpanded VIC, 38400. It's ordered just like screen memory, from 0–999 on the 64 or 0–505 on the VIC. When you POKE to screen memory, also POKE to color memory. We'll use red as the color (red is the third color, and since colors start with 0, we use a value of two):

```
POKE 38400+12*22+20,2 (VIC)
POKE 55296+12*40+20,2 (64)
```

Naturally, you'll want to save the computer time, so you can solve the arithmetic to make the computer's job a little easier (and faster):

```
POKE 7964,1:POKE 38684,2 (VIC)
POKE 1524,1:POKE 55796,2 (64)
```

Why use POKE at all? Why won't PRINT serve? Well, POKE is more convenient than PRINT in that PRINT tends to be serial. It prints left to right. You can move the cursor to any position with cursor controls, but it's a little cumbersome to program. POKE gives you direct access to any location on the screen.

Also, PRINT can display to the screen, but there is no command in BASIC to read a character off the screen. In Pudding Mountain Miner, the bomb falls as long as there is a blank space underneath it. The program keeps dropping the bomb until it reads a solid character from the screen. The PEEK command is used to read memory, in this case, screen memory. It makes sense to use POKE when you must use PEEK, since the numbers are the same. For example, to see what character is at row 20 and column 3, use:

```
A=PEEK(8123) VIC (7680+20*22+3)
A=PEEK(1827) 64 (1024+20*40+3)
```

The numeric value of the character is returned in the variable A.

Line-By-Line Description

A line-by-line description is a good way to show how a program works. It's also a valuable reference tool when you come back to work on a big program months later.

```
100 V=(PEEK(0)=76):W=40+18*V:T=1024-
    6656*V:C=55296+16896*V:S=53281+16402*V
```

This is a very busy line. First of all, we need to know which machine the game is running on, so that we can make adjustments as we go along. Location 0 on the VIC normally holds a 76, and you wouldn't find a 76 in location 0 on the 64. The expression in parentheses is asking for a comparison. Is PEEK(0)=76? If so, the variable V is set to −1 for true, or 0 for false. This kind of trick is valuable. It can save you time and memory in your programming. For example, to add 1 to a number, unless the number is greater than 5, we could use: N=N−(N<6). If N<6, the expression in parentheses evaluates to a −1, and N−1 is the same as N+1. When N is greater than 5, (N<6) comes out to 0, and N+0 does no addition.

So if the program is running on a VIC, V=(PEEK(0)=76) is −1, otherwise V=0 on the 64. We use this variable in the next statement. W stands for the width of the screen. W should be 40 for the 64, and 22 for the VIC. If V=−1 (VIC), then 18 will be subtracted from 40 (W=40+18*V), making W=22, otherwise 40−18*0 is still 40 for the 64. We use this same trick to resolve T to either 1024 (the start of screen memory on the 64) or 7680 (1024−6656*−1). And C is either 55296 for the 64, or 38400 for the VIC. The location used to change the background color of the screen, S, is also calculated for the VIC or 64. So we've already generalized the program. We can use the same program lines on the VIC or 64, since the values which are different are already out of the way. We can POKE to S and know that we are automatically POKEing to the right location for the right machine.

```
110 C$=CHR$(147):PRINTC$:POKES,1-26*V:
    FORI=0TOW-1:Q=22*W+I
115 POKET+Q,160:POKEC+Q,7:NEXT
```

Here we define C$ as the character value of Clear Screen. When we PRINT C$, the screen clears. This is the same character as SHIFT-CLR/HOME. We could put this clear screen character inside quotes, but it's a strange character that's hard for people to type in without instructions (remember this program ran in a newspaper ad). The use of CHR$ means that whoever types in the program won't have to worry about things like quote mode. This kind of programming is helpful when you intend to publish a program in printed form. C$ is used whenever we want to clear the screen.

We next change the screen color to white. The statement POKE S,1−26*V resolves to POKE 53281,1 for the 64, or POKE 36879,27 on the VIC. We now draw the base of the mountain across the bottom of the screen. The FOR-NEXT loop ranges from 0–21 or 0–39, according to the value of W, the width of the screen. Q is used as the offset from screen memory. The row number, 22, is multiplied by the column width, then we add in the column number, I (the index of the FOR-NEXT loop). We POKE T+Q (start of screen memory plus offset) with a solid square (screen-code value 160). The color is yellow (7).

```
120 S$=CHR$(32)+CHR$(158)+CHR$(18)+CHR$
    (188)+CHR$(146)+CHR$(156)+CHR$(185)
130 S$=S$+CHR$(31)+CHR$(175):Q=RND(1)*
    (W-7)+3+22*W:POKET+Q,164:POKE C+Q,5
```

Lines 120 and 130 build up the airplane figure one character at a time, using the graphics characters and reverse-field (again, refer to the figure). The string is built by concatenation, using the + sign. We then pick a random horizontal position for the gold (a green dollar sign), and POKE a dollar sign into screen memory, and green into color memory. Randomness makes a game different every time you play it.

```
140 FORI=0TOW-1:FORJ=0TO7*RND(1):
    Q=(21-J)*W+I:POKET+Q,160:
    POKEC+Q,2:NEXT:NEXT
```

We now build the mountain. The mountain is drawn left to right, one column at a time. Each column is from 1 to 8 characters high, with the height chosen randomly. We use two FOR-NEXT loops. The outer loop moves the index from left to right (0–21 or 0–39) and the inner loop indexes from top to bottom. We use the RND statement to change the limit of the inner FOR-NEXT loop each column. Inside the inner loop, we compute the character position using Q. The bottom of the mountain is row 21 (counting from 0). The index J is subtracted to get the current row within the loop. This is multiplied by the width of the screen, then the column (I) is added in. We then POKE this location with a solid red square (appears chocolate pudding brown if you adjust your TV and your imagination). The NEXTs close up the loops, drawing the entire mountain.

```
150 PRINTCHR$(142);CHR$(19);:Y%=4*RND
    (1)+1:FORI=1TOY%:PRINT:NEXT:X=0
```

We print CHR$(142), which forces the display to uppercase, then CHR$(19), the HOME key, which puts the cursor in the upper left corner of the screen. We now pick a random row for the airplane, so that it will choose a new height each time. We now execute some PRINTs within a loop to put the cursor from 1 to 4 lines down on the screen. Finally, we initialize X to 0. X will be used below for the horizontal position of the airplane. We want to start from left to right.

```
160 L$=CHR$(157):PRINTS$;L$;L$;L$;:X=X+1:
    GETA$:IFA$=""ANDX<W-4THEN160
```

L$ is defined as cursor-left, which is shorter to type than CHR$(157) over and over again. When printed, a cursor-left moves the cursor to the left one space. We print the airplane (the whole airplane is stored in the variable S$), then back the cursor onto the first character of the airplane. We'll print spaces on top of the airplane to erase it, then redraw the plane to make it move. The variable X, used to represent the horizontal position of the plane, is upped to the next position of the plane. We also check here for a bomb being dropped. If any key is pressed, and if the plane hasn't reached the far right edge of the screen, we go to the part of the program that drops the bomb. Otherwise, we continue to the next line.

```
170 IFX=W-4THENPRINTTAB(X);CHR$(32);CHR$
    (32);CHR$(32);:GOTO 150
```

If the plane has reached the right edge of the screen (IF X=W-4), we use TAB to put the cursor on the plane, CHR$(32) (a blank space) to erase the plane, then we restart the plane at the the left side of the screen by jumping back to line 150.

```
180 FORI=Y%+2TO22:Q=I*W+X+1:
    P=PEEK(T+Q)
190 POKET+Q-W,32:POKET+Q,90:POKEC+Q,
    8*RND(1):IFP=32THENNEXT
```

The plane is on row Y%, previously calculated on line 150. The bomb should drop from underneath the plane. We start a FOR-NEXT loop to represent the vertical position of the bomb, from 2 characters under the plane to where the bomb reaches the base of the mountain. Q is used again to calculate the screen position of where we'll put the bomb. We PEEK the intended position of the bomb so we can see later if we've hit something, then erase the previous bomb character (even if this is the first time through the loop, where there would be no bomb). Animation looks better if you erase the old shape, then draw the new one—instead of immediately drawing and erasing, which causes more flickering. We next POKE in a character for the bomb, and color it randomly. As long as the bomb falls onto spaces (IF P=32), we continue to drop the bomb. The FOR-NEXT loop ends when something has been hit.

```
200 B=B+1:POKET+Q,32:IFI<22GOTO160
```

The bomb has hit something, so we add one to the variable B, which represents the total number of bombs used. We then erase the bomb left by the loop. As long as the loop never made it to the base, we've just chipped away at the mountain, and it's time to continue moving the airplane (IF I<22 GOTO 160). By the way, it's perfectly legal to use GOTO after an IF without THEN.

```
210 IFP<>164THENFORI=0TO255:POKEC+Q,I:
    POKET+Q,I:NEXT:PRINTC$;"YOU
    LOST":GOTO230
```

Since (IF I<22) failed, line 210 is executing, so the bomb hit a character at the base of the mountain. If what the bomb hit (P) is not equal to 164, the value of the dollar sign, then the player has chipped his way into the base, destroying the mountain. We create a mediocre explosion by POKEing the characters from 0–255 into screen and color memory, then inform the player of his demise. We jump to line 230 to wait for the player to press any key to play again.

```
220 FORI=1TO50:POKET+Q,32+132*F:F=1-F:
    NEXT:PRINTC$;"YOU WON! ";B;"BOMBS"
```

The IF statement on line 210 had to fail in order to get here, so the player must have bombed the dollar sign. The goal is achieved; the game is over. We blink the position of the dollar sign by alternating between a space and a dollar sign. When F=1, 32+132*F resolves to 164, the value of the dollar sign, and we POKE in a 32 (the space character) when F=0. The statement F=1-F makes F alternate between 0 and 1. We print the message informing the player how many bombs he used, then fall through to the next line.

```
230 PRINT:PRINT"PRESS ";CHR$(18);"RETURN";
    CHR$(146);" TO PLAY AGAIN"
240 GETA$:IFA$<>CHR$(13)THEN240
250 RUN
```

We use CHR$(18) to make the word "RETURN" show up in reverse-video, to remind the player that we mean to press the RETURN key, not the individual letters R-E-T-U-R-N. In line 240, we wait for the RETURN key, which has a value of 13, to be pressed. After RETURN is pressed, the game reruns.

Program Evolution

This is such a small program, there is plenty of room for enhancements. A great way to learn programming is to modify other people's programs. You customize "canned" software to your taste, then use your knowledge to write programs of your own. The game can be made more complex. It's crying out for sound effects. Try using custom characters for a really professional look. Add more rules, even more screens. It's up to you. I'd be interested in seeing what you come up with. Even if you're not interested in games, this program is actually drawing bar graphs (the mountain). You can use these tricks to master screen formatting and can also learn a lot about writing applications programs by studying games.

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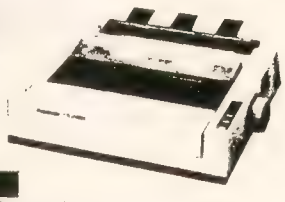

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NoZap: Automatic Program Saver

J. Blake Lambert, Assistant Editor

This short, useful disk routine automatically saves updated versions of the BASIC program you're working on. It also works with some ML assemblers, and is especially useful for those who live in areas where power dropouts frequently occur. For the Commodore 64 and VIC-20 with or without expansion.

If you've ever been zapped by a power dropout or a loose power plug and seen the ominous reset message, you know how it feels. The cost is high: your time and your work. It's easy to say *always make periodic backup copies as you type in or write programs.* But when the ideas are flowing, it's also easy to forget or procrastinate. "NoZap" does more than remind you—it does the save for you, periodically and automatically.

NoZap is not a surge protector (it won't protect your computer from hardware damage resulting from a power spike). But it will protect you from momentary electric dropouts and loose connections that can cost you time and effort. Once you've run NoZap and entered a filename, it will save the current version of the program every ten minutes with an updated filename. You don't have to do anything you don't normally do—the operation is totally transparent. Every ten minutes, NoZap waits until you finish the line you're working on, and when you press RETURN to enter the line, it automatically saves.

NoZap even works with some programming utilities and typing aids. For example, it works with the Automatic Proofreader, but not SpeedScript or MLX. (Since MLX is a BASIC program, NoZap will back up the MLX program rather than the ML program you're entering.) It works with the DOS 5.1 and VIC Wedges, as well as with some assemblers, such as PAL and LADS.

NoZap keeps track of the size of the program you're working on, as well as automatically stamping a version number onto the beginning of the filename. NoZap can accommodate as many as 100 versions, numbered 01–99 (after 99, the version number rolls over to 00).

There are a couple of limits which NoZap cannot work around: disk space and directory space. If there are not enough blocks free, the program won't be saved. And the directory can hold no more than 144 filenames.

Using NoZap

To use NoZap, load and run Program 1 (for the VIC) or Program 2 (for the 64); these are BASIC loaders. The program POKEs a machine language program into the current top of BASIC memory and protects it from BASIC variables. Program 1 works with all VIC configurations (with or without memory expansion). NoZap also uses memory from 739–767, so be careful to avoid putting any ML routines there.

After you've run NoZap, the title line appears, and on the next line you see the prompt:

```
FILENAME?
```

Enter a filename (without quotes) from zero to fourteen characters long and press RETURN.

(Don't try to use a filename longer than fourteen characters, as this can cause your computer to lock up.) You don't need to include the version number, since NoZap adds that for you. Next, type NEW and press RETURN. From this point on, simply program as you normally would. NoZap is in charge of your saves, although you may continue to use the normal SAVE command. The first time NoZap saves, it uses a version number of 01. For example, if you enter THOR as the filename, the first version will be 01THOR, the second, 02THOR, and so on. NoZap reports the disk status, but will not retry if there is an error.

Forced Saves And Toggling

Occasionally you may want to save a new version before the next NoZap save. Or you may want to turn NoZap off for a while. To do so, use these commands:

```
SYS 739 (forced save)
SYS 745 (toggle off and on)
```

Typing SYS 739 increments the version number and saves the program. NoZap resets its timer so the next save will occur ten minutes later.

If you want to turn NoZap off, type SYS 745. This SYS acts as a *toggle*, so if you SYS 745 again, NoZap will restart as if it had been run for the first time.

Zapping NoZap

NoZap has been written to prevent it from interfering with your programming— RUN/STOP–RESTORE *does not deactivate it*. Turn the computer off then on again, or SYS 64738 on the 64, or 64802 on the VIC.

There are also ways to trick NoZap to your advantage. For example, if you stop at 04THOR one evening, the next time you program, run NoZap, entering the filename THOR again. To defeat saves, open the gate on the disk drive (and remove the disk if you like). To bump the version number up, SYS 739 repeatedly until you reach the desired number. Leaving the gate open will also help you avoid saving something in memory that you don't wish to save (like the disk directory). You may have to initialize the drive (or turn it off and on) to get it to respond after this, since the drive protects itself by not repeatedly trying to operate with the gate open.

Wild Cards And Pattern Matches

Since the version numbers are at the beginning of the filename, you can list all the versions of THOR with

```
LOAD"$0:??THOR",8
LIST
```

or, using the wedge command,

```
@$0:??THOR
```

If the program name is long, you may want to use pattern matching as well. For example, versions of THORSREVENGE could be viewed with the wedge command,

```
@$0:??THORS*
```

This is subject to the normal rules of pattern matching.

When you have a final version, you may want to do a normal save of the program, using a unique name, like FINALTHOR. You can then scratch all of the NoZap-saved versions of THOR with the following wedge command:

```
@S0:??THOR
```

Note that it's usually best not to use pattern matching when scratching files to avoid erasing files accidentally.

How NoZap Works

NoZap takes advantage of the fact that many BASIC and Kernal routines are *vectored*. A vector is like a roadsign that tells the computer the location of a routine. Since the vector is in RAM, it can be changed to point to your own routine, the same way a detour sign guides you when traffic is rerouted. A program that uses such a detour is called a *wedge*.

NoZap sets up a detour in the Main BASIC Loop, the part of BASIC that takes in program lines as they are entered (in direct mode). As a result, BASIC will take the NoZap detour each time you press RETURN. When you run NoZap and enter a filename, the name is placed in a filename buffer, just after the current version number. The vector at locations $302–303, which points to the Main BASIC Loop, is altered, and one of the computer's internal timers is set to zero. It is this timer that NoZap checks as you enter each program line. The 64 version uses one of the 64's TOD (time of day) clocks at locations $DC08–DC0A, and the VIC version checks the jiffy clock at locations $A0–$A2. (Tape operations will affect the timer in the VIC version.) If the timer has not counted to ten minutes, NoZap sends the computer back to the Main BASIC Loop (at $A483 in the 64, $C483 in the VIC). This completes the NoZap detour.

Since NoZap wedges into the Main vector at $302–303, it is not compatible with programming utilities which use the same technique. You may have to experiment to find out which utilities will work with NoZap in place. Another source of conflict is programs that want to use the same section of memory.

Clock Strikes Ten

If the timer has counted up far enough, NoZap continues, adding one to the version number in the filename buffer, then using the Kernal SETNAM, SETLFS, and SAVE routines. NoZap determines what area of memory to save by looking at the pointers to the start and end of BASIC program text ($2B–2C and $2D–2E, respectively). Then it checks the error channel and finishes the SAVE routine, returning to the Main Loop again.

The above description is brief, so use a machine language monitor to disassemble NoZap if you wish to look at all of the details. In addition, the BASIC loader POKEs in two short routines. The first, which starts at 739 decimal, sets the timer to trick NoZap into thinking the time is up. This forces an earlier save.

The second routine is a NoZap pointer. Located at 745, the routine consists of a JuMP to the starting address of the NoZap initialization routine. When you run the BASIC loader, this address is placed in its correct form in addresses 746–747. This means that no matter where NoZap locates, you can toggle it on and off with SYS 745.

Customizing NoZap

After you've typed in, saved, *and tested* the BASIC loader for your computer, you may want to customize it to suit your preferences. One easy modification is to change the interval between saves. While the normal value is ten minutes, NoZap maintains a counter which allows you to use an interval of 20 minutes or more. To change the time between saves to 20 minutes, for example, change the 1 in line 42 to a 2. Change it to 3 for 30 minutes, and so on. You must also increase the checksum number in line 102 by the same amount as you increase the counter value.

One side effect of changing the interval is that you must SYS 739 repeatedly to do a forced save. For example, if you change the counter value to 2, you must SYS 739 twice to do a forced save, and three times if the counter is set to 3. To avoid this problem, a simpler way to force a save when the counter is set to 2 or higher is

```
POKE 750,1: SYS 739
```

NoZap can be a lifesaver. It can take the worry out of losing files unexpectedly and let you concentrate on programming.

See program listings on page 123.

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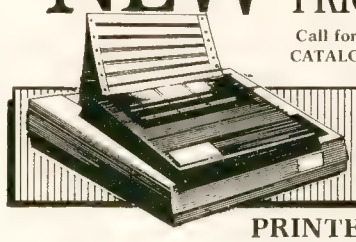

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1526 Hi-Res Screen Dump

Michael Frantz

Load this program into your 64, type one command, and get a high-resolution screen dump on your Commodore 1526 printer.

The October 1984 GAZETTE contained a program for printing hi-res screens to the Commodore 1525 and MPS-801 printers. Unfortunately, owners of the Commodore 1526 still had no way of printing their hi-res pictures. This program solves that problem.

"1526 Hi-Res Screen Dump" is written in machine language (ML). A BASIC program reads in the ML program from DATA statements and POKEs it into memory above BASIC at 49152. An internal checksum (in addition to the one used with "Automatic Proofreader") tells you if you've made any typing errors.

Program operation is simple. Load 1526 Hi-Res Screen Dump first, and type RUN. Next, load the hi-res screen or the program that generates it. With the hi-res picture displayed, type **SYS 49152** "blindly" (that is, you won't see the characters you're typing—they're not on the hi-res screen) and the picture will begin printing on the 1526. Because the program automatically finds the starting location of the hi-res screen, you must be able to see the screen when you SYS or the program won't know where to find the location of the hi-res screen.

There are two ways to execute the program. The first is described above; the other is to issue the command from within a program. For example, you can append a line with the SYS command to the end of a program that draws a hi-res screen. If the last line in your hi-res program is 940, you can add **950 SYS49152** to execute the dump.

If you wish to print a hi-res screen without the hi-res screen displayed, these POKEs must be made:

POKE 49198,169
POKE 49199, (with high byte of screen starting address)
POKE 49200,76
POKE 49201,60
POKE 49202,192

Note that these POKEs will disable the routine that calculates the address of the hi-res screen, so you'll have to do the calculations. Also, these POKEs can be appended to your hi-res program by giving them line numbers. The SYS command will again be the last program line.

See program listing on page 140.

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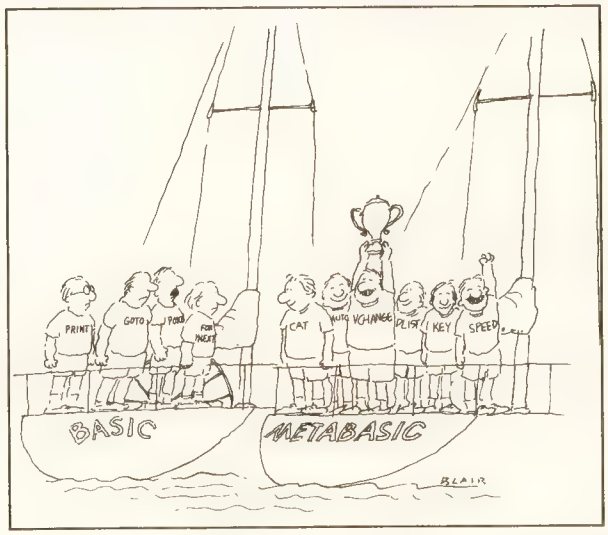

Here's a utility that will change the way you program. It adds 32 new debugging and testing commands to Commodore 64 BASIC, working by itself or in conjunction with a machine language monitor/assembler.

You've bought your first car and it runs well. But when you take it out on the highway, you're dismayed to find that it won't go faster than 45 miles per hour. What do you do?

Take it to your favorite mechanic and he might give you three options: Remove the engine and replace it with a brand new one. Or add some fancy turbo-charging fuel-injected doohickeys to the engine you already have. Or, without adding anything, you could tune it up, using a special machine that measures the engine's performance.

A BASIC Tune-Up

You can add new programming commands to your 64 in three similar ways. The first is to toss out BASIC and create a whole new language (a more powerful engine) based on your ideas of what a programming language should do.

The second method, a language extension, keeps BASIC but adds some new programming commands (for sound, high-res graphics, or other specialized functions). You keep the BASIC engine, but add some additional parts which make it work faster or more efficiently. *Simons' BASIC* and the *Super Expander 64* are examples of an extension.

The third way is like a tune-up which doesn't change the engine. You add direct mode commands for debugging. This is not a new language or even an extension of BASIC, it's more properly called a *development system* or *writing/debugging tool.* The new commands you add cannot be used inside a program, they work only in immediate mode.

New languages and extensions have several advantages. But they also have a major drawback: You have to load the language or extension *before* you load the main program, or the program just won't work.

The nice thing about a development system like "MetaBASIC" is that it's there when you need it, during the time you're writing and tuning up a program. But once you've finished the program, you don't need MetaBASIC to run it—you can disconnect the tune-up machine.

An Introduction To MetaBASIC

MetaBASIC uses English mnemonics, so you don't have to memorize a lot of SYS numbers. And if you forget the new words, you can either refer back to this article or type HELP.

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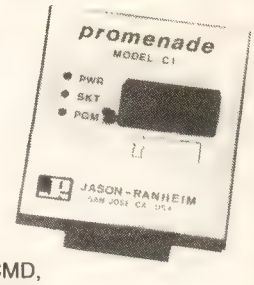

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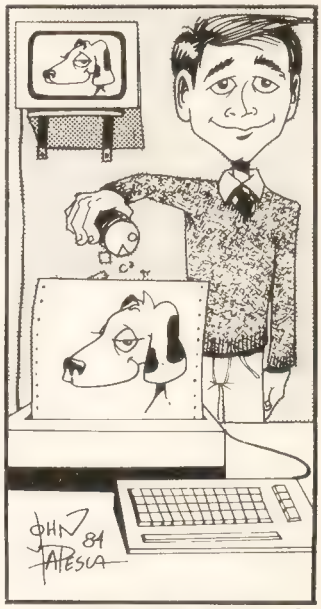

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MetaBASIC Commands

Here's an alphabetical list of the new commands and how to use them, with examples. MetaBASIC commands and strings appear in **boldface** and numbers appear in *italics*. Anything enclosed in parentheses is optional.

If something is described as a disk command, it won't work unless you have a disk drive. However, some of the ML programming aids can be useful in BASIC and vice versa.

AUTO—BASIC Programming

Syntax: **AUTO** *startnum, increment*

AUTO can take some of the drudgery out of writing a program. It automatically numbers a program, starting at the first number, incrementing by the second. Separate the numbers with a comma. After you press RETURN over a line, the next number is automatically printed. The current line number can be changed by using the INST/DEL (delete) key and replacing it with another number.

Press RUN/STOP to escape from AUTO.

Example: **AUTO100,10** starts at 100 and numbers by 10.

BSAVE—Disk Command (see also RESAVE)

Syntax: **BSAVE "filename",** *start address, end address + 1*

BSAVE (Binary SAVE) saves a chunk of memory to disk, from the starting address to the ending address. Put the program name inside quotation marks, and use commas to separate the name, starting address, and ending address. It's important that you add one to the actual ending address. You can use this command to make backups of machine language programs, as long as you know the starting and ending addresses. BSAVE can also function to save sections of screen memory, custom character sets, or high-res screens.

The numbers should be in decimal. If you need to translate from hexadecimal to decimal, see NUMBER (below).

After you BSAVE to disk, you can load it back with LOAD *"filename"*,8,1.

Example: **BSAVE "METABASIC" ,36864 ,40961** to make a customized backup of MetaBASIC. By saving 100 bytes past the actual end of the program, you conveniently save all previously entered DEFAULT and KEY definitions. The next time you load the BSAVEd MetaBASIC, type INT and DEFAULT to regain them.

CAT—Disk Command (see also DLIST, READ)

Syntax: **CAT**

Anytime you want to look at the entire disk directory, use CAT (for CATalog). The BASIC program currently in memory will remain undisturbed. To see specific portions of the directory, see DLIST.

CHANGE—BASIC Programming (see also FIND, VCHANGE)

Syntax: **CHANGE @OLD@NEW@** (*,startnum, endnum*)

or **CHANGE @"OLD"@"NEW"@** (*,startnum, endnum*)

CHANGE searches through the program in memory, changing every occurrence of the old string to the new one. The strings can be up to 30 characters long, and must be bracketed by the commercial at sign (@). All lines in which changes are made are listed to the screen.

The first format will change BASIC commands and variable names. The second format should be used to change strings. If you omit the line numbers, CHANGE affects the whole program. If you want to change only one section, add the starting and ending line numbers, marked off by commas.

Example: **CHANGE @X@QQ@,1,200** changes the variable X to QQ in lines 1–200. To change the name Charles to John throughout the program, **CHANGE @"CHARLES"@"JOHN"@**.

DEFAULT—MetaBASIC Command (see also INT, QUIT)

Syntax: **DEFAULT** *border, background, text, device#*

When you hit RUN/STOP–RESTORE, the screen reverts to the default colors of light blue characters on a dark blue screen, whether you like it or not. And several commands like LOAD and SAVE default to tape. DEFAULT lets you change these values to whatever you prefer.

If you have a disk drive, you can change the device number to 8. If you want to use your second drive (device nine) for SAVEs, change the default to 9. If your 64 is hooked up to a black-and-white TV, change the character/background color to a more readable combination.

Note: You cannot use any of the new disk commands once you change the default device number to 1 (tape). To disable DEFAULT (and go back to normal), use the MONITOR

command below.

Example: **DEFAULT1,1,0,8** changes border and background to white, characters to black, and device number to 8. If you press RUN/STOP–RESTORE, you'll see black characters on a white background. And you'll be able to type SAVE"*filename*" (without adding a ,8).

DELETE—BASIC Programming

Syntax: **DELETE** *startnum–endnum*

DELETE removes a range of lines from your program. Separate the starting line number from the ending number with a dash (–).

Example: **DELETE200–250** erases lines 200–250.

DLIST—Disk Command (see also CAT, READ)

Syntax: **DLIST "filename"**

This command lists a BASIC program from disk to the screen, without affecting what's currently in memory. The program name must be enclosed in quotation marks. DLIST enables you to look at a program before using MERGE or SCRATCH.

It also allows you to read portions of the directory. DLIST "$:A*" displays all disk files beginning with the letter A.

Example: DLIST "BASICPROGRAM" reads the file from disk and lists it to the screen.

DUMP—BASIC Programming

Syntax: **DUMP**

Use DUMP to examine the current values of all non-array variables in a program. If the program is running, press RUN/STOP and type DUMP. To resume, type CONT.

ERR—Disk Command

Syntax: **ERR**

ERR reads the disk error channel. Use it when the red light on the disk drive starts blinking.

FIND—BASIC Programming (see also CHANGE, VCHANGE)

Syntax: **FIND @string@** (,*startnum*, *endnum*)
or **FIND @"string"@** (,*startnum*, *endnum*)

This allows you to find any word, variable, or other string within a program. Each line containing the search string is listed to the screen. If you wish to search just one section of the program, add the starting and ending line numbers, separated by commas.

If you're trying to find BASIC keywords (like PRINT or REM), use the first format. It also works for variables and numbers. The second format should be used when you're looking for strings or items inside quotation marks.

Example: **FIND @A=@** searches for lines where variable A is defined.

HELP—MetaBASIC Command

Syntax: **HELP**

Whenever you are unsure of the commands available in MetaBASIC, type HELP for a complete list.

INT—MetaBASIC Command (see also DEFAULT, QUIT)

Syntax: **INT**

Some features of MetaBASIC are interrupt-driven. If you reset the interrupts (with the MONITOR command), the function keys and the SPEED function may no longer work. INT puts the interrupts back in place.

KEY—BASIC Programming (see also INT)

Syntax: **KEY** *function#*, **"command or string"**

This command adds a lot of flexibility to MetaBASIC, allowing you to define each of the eight function keys as a different command or string.

The command, up to ten letters in length, must be inside quotation marks. There are two special characters. The back arrow acts as a carriage return, so you don't have to press RETURN after BASIC commands. Also, the apostrophe (SHIFT-7) counts as a double quotation mark.

Using KEY, you can load other utilities you may own, and SYS to them with a tap of a function key. Or you can do a one-key RUN or LIST.

If you want to permanently define the function keys and screen/text colors, you can use KEY and DEFAULT and then BSAVE "MetaBASIC" using the starting and ending addresses above. The definitions will be saved along with the program.

If the interrupts are accidentally reset, you may have to use the INT command to re-enable the KEY function.

Examples:

KEY1,"{CLR}LIST100–←" clears the screen and lists from line 100 on whenever you press f1 (the back arrow means RETURN will happen automatically). You could also abbreviate LIST with L SHIFT-I.

KEY7,"DATA" could be useful with automatic line numbering (see AUTO) if you're writing a program with a lot of DATA state-

ments. After entering a line, press RETURN and you'll see the next line number. Then press f7 and the word DATA automatically appears.

KEY2,"VERIFY"'*'←" defines f2 to print VERIFY"*" plus a RETURN (note the apostrophes have been changed to quotation marks). If you've used DEFAULT to change the device number to 8, pressing f2 will automatically verify the program most recently saved to disk.

LLIST—Printer Command

Syntax: **LLIST** (*startnum-endnum*)

This command lists a program, but the listing is sent to a printer rather than to the screen. Line numbers are optional. The syntax for LLIST is identical to the regular LIST.

Example: **LLIST10-20** to list lines 10–20 to the printer.

MEMORY—ML Programming (see also @)

Syntax: **MEMORY** *start address (-end address)*

You can examine any section of memory with this command. Use decimal numbers (not hex) for the starting and ending addresses. The values in memory are displayed, six bytes per line, in decimal. In addition, the equivalent ASCII characters are printed in reverse to the right (if there's no corresponding ASCII character, a period is printed).

If you omit the ending address, MEMORY 43 for example, you'll see the contents of two bytes (43 and 44). This makes it easier to look at two byte pointers—like 43 and 44 which point to the beginning of BASIC memory.

To change memory, you can use the @ command, described below.

Example: Enter **MEMORY 41374-41474** and you'll see the first few error messages (note that the ASCII value of the last character is always added to 128). Or, load a BASIC program, and type **MEMORY 2048-2148** to see how programs are stored in memory.

MERGE—Disk Command

Syntax: **MERGE "program name"**

MERGE reads a program from disk, lists each line to the screen, and adds the line to the program in memory. If the programs have common line numbers, the program on disk takes precedence. Say they both contain a line 250. The line 250 from the disk program will replace line 250 in memory.

Before using this command, you may want to use DLIST to make sure you're merging the right program. And if there are conflicting line numbers, you can use RENUM to renumber one of the two programs. If you want to merge just part of one program, use DELETE to eliminate the unwanted lines.

MONITOR—ML Programming (see also INT)

Syntax: **MONITOR**

If you have a machine language monitor in memory, you can enter it with MONITOR (providing it is enabled with a BRK). To use MetaBASIC with a monitor, you must load MetaBASIC, type NEW, and SYS36864. Next, load the monitor, type NEW, and SYS to the starting address (which will set up the BRK vector to point to the monitor).

MONITOR does several other things, as well. It changes border, background, and text colors back to their default values (light blue on dark blue). It also sets interrupts to normal, which disables the function key definitions (see KEY) and SPEED command. You can get them back with the INT command.

NUMBER—ML Programming

Syntax: **NUMBER $***hexnum*
or **NUMBER** *decnum*

NUMBER allows you to convert back and forth between decimal and hexadecimal. Put a dollar sign ($) in front of hex numbers. In addition, the number is converted to low-byte/high-byte format (in decimal) and the equivalent binary number (marked by a percent sign).

Examples:

```
NUMBER $100
256
0 1
%100000000
NUMBER 34
$22
34 0
%100010
```

QUIT—MetaBASIC Command

Syntax: **QUIT**

This resets all vectors and disables all MetaBASIC commands. The one thing it does *not* do is restore the top of memory pointer. MetaBASIC is still protected from BASIC. Reenter the program with SYS36864 or SYS9*4096.

READ—Disk Command (see also CAT, DLIST)

Syntax: **READ "seq filename"**

READ allows you to examine sequential disk files. The information in the file is displayed to

the screen, without altering whatever program is in memory.

In the rare case that you want to use the BASIC READ command from direct mode (to see if all DATA statements have been read), you can precede it with a colon.

RENUM—BASIC Programming

Syntax: **RENUM** (*startnum*)(,*increment*)

This command renumbers the entire BASIC program in memory (you can't renumber just part of the program), starting at the specified line number. The increment size is optional; RENUM defaults to 10. If you omit the starting number, it will start at line 10.

In addition to renumbering BASIC lines, all references in GOTOs, GOSUBs, ON-GOTOs, ON-GOSUBs, IF-THENs, etc. are taken care of. One word of caution: GOTO is covered, but GO TO (with a space in the middle) is not. Use FIND before renumbering to look for occurrences of GO TO.

Example: **RENUM 100,20** renumbers a program, starting at line 100, counting up by 20s.

RESAVE—Disk Command (see also BSAVE)

Syntax: **RESAVE "filename"**

The disk command save-with-replace (SAVE "@:*filename*") first saves the program and then scratches the older version, so there must always be enough free space on the disk for the new version of the program. This can cause problems if you don't have enough available space.

Save-with-replace is also sometimes unreliable and should be avoided (although some experts dispute this).

RESAVE reverses the order—first it scratches the old version of your program from disk, and then does a regular SAVE, solving both of the above problems.

SCRATCH—Disk Command

Syntax: **SCRATCH "filename"**

SCRATCH does the same thing as OPEN 15,8,15: PRINT#15,"S0:*filename*": CLOSE 15, but it's easier to type. It scratches a file from the disk. If you have just inserted the disk into the drive, it's a good idea to initialize it first (see SEND). You can use wildcards to scratch more than one program—SCRATCH "A*" will get rid of all files beginning with the letter A.

Example: **SCRATCH "SPACEGAME"** removes the program named SPACEGAME from the disk.

SEND—Disk Command

Syntax: **SEND "disk command"**

This is a convenient way to send disk commands to channel 15. SEND"I0" initializes the drive, SEND"V0" validates the disk, SEND "R0:*newname*=*oldname*" renames a disk file, and so on. For more information about disk commands, see the 1541 User's Manual.

SPEED—BASIC Programming

Syntax: **SPEED** *number*

SPEED followed by a number from 0 to 255 changes the printing speed. The higher the number, the slower the speed. Try typing SPEED 255 (the slowest you can make it) and then list a program. You can get back to normal with SPEED 0. If it doesn't work, try using INT (see above) to correct the interrupts.

SPEED is also useful when you're using the TRACE command.

START—Disk Command

Syntax: **START "filename"**

If you forget where a machine language program begins, put the disk in the drive and use this command. This can help when you have forgotten the SYS that starts a program.

Example: **START "METABASIC"** should display 36864 on the screen.

TERMINAL—Modem Command

Syntax: **TERMINAL**

If you own a Commodore modem (and it's plugged into your 64), TERMINAL transforms your computer into a 300 baud "dumb" terminal you can use to talk to standard-ASCII bulletin boards or information services like CompuServe. You can't change any of the default parameters (like full-duplex), nor can you upload or download text or programs.

To return to BASIC, press the £ (English pound) key; do not press RUN/STOP–RESTORE. A note of caution: Memory locations 52736–53247 are used for buffers, so any program in this area will be overwritten.

TRACE—BASIC Programming (see also TROFF)

Syntax: **TRACE** followed by RUN.

If you're debugging a BASIC program, TRACE helps you see what's happening. As each line is executed, its line number is printed on the screen. Use the SHIFT or CTRL key to temporarily halt the program. SPEED controls the speed of execution, and TROFF turns off TRACE.

TROFF—BASIC Programming (see also TRACE)
Syntax: **TROFF**
This command turns off the TRACE function.

UNNEW—BASIC Programming
Syntax: **UNNEW**
You may never need this command, but it's nice to have it available. If you accidentally type NEW and you want to retrieve the program, use UNNEW to get it back.

VCHANGE—BASIC Programming (see also CHANGE, FIND)
Syntax: **VCHANGE @OLD@NEW@** (,*startnum*, *endnum*)
or **VCHANGE @"OLD"@"NEW"@** (,*startnum*, *endnum*)
VCHANGE (Verify CHANGE) works just like CHANGE (see above), except you get to choose whether or not the change is made. Each line containing the old string is displayed, with each occurrence of the string marked with a filled-in circle. If you press Y, the change is made. Press N if you want to skip to the next one.

@—ML Programming (see also MEMORY)
Syntax: **@** *start address*, *number*, *number*....
This works like POKE, except it allows you to put a series of numbers into consecutive memory locations. For example, if you want to change border and background color to white, you would use @53280,1,1. The first 1 goes into 53280, the second into 53281. If you add more numbers, separated by commas, they are POKEd into the next locations: 53282, 53283, and so on.

You can also use this in conjunction with MEMORY. First, PEEK at a series of locations using MEMORY. Then change the information there by putting @ before each line you want to change. Cursor over to the number you want to change, change it, and press RETURN.

Typing It In

MetaBASIC is written entirely in machine language, and MLX is required to type it in.

If you don't already have a copy of MLX for the 64, type it in and save it to tape or disk.

The program resides at the top of memory, where BASIC programs (including MLX) store dynamic strings. To protect this section of memory, you must enter POKE644,144:SYS58260 before loading MLX. Otherwise, the variables will overwrite MetaBASIC. Then, load MLX and run it. Give it the following information:

Starting Address: 36864
Ending Address: 40805

Next, following the MLX instructions, enter MetaBASIC and save it.

To use MetaBASIC, follow these steps:

1. LOAD"MetaBASIC",8,1 (for disk) or LOAD"MetaBASIC",1,1 (tape).
2. Type NEW
3. SYS36864 (or SYS9*4096)

The program uses 4K at the top of BASIC memory (which leaves you with 35K for your programs). The first thing it does is move the top of BASIC pointer down, to protect itself from variables. After the SYS, it may seem that nothing is happening. But MetaBASIC is running in the background, and you now have 32 new commands to help you write and debug programs.

Special Notes

Always type NEW after loading MetaBASIC.

One feature that works automatically is LIST Pause. When you're listing a program, hold down CTRL, SHIFT, or the Commodore key to temporarily halt it.

RUN/STOP–RESTORE is available in both program mode and direct mode. But if you want to interrupt any of the utilities like RENUM, use the RUN/STOP key by itself (not RUN/STOP–RESTORE).

The commands work only in direct mode; you cannot add them to programs. Also, you're limited to one command per line (although you can still use multi-statement lines inside your programs). Unlike ordinary BASIC commands, there are no abbreviations. You must type out the entire MetaBASIC command. If it seems to be working incorrectly, make sure the syntax is correct.

Machine language programmers should remember that MetaBASIC occupies memory locations $9000–9FFF. The 4K which begins at $C000 is available for programs like Micromon or for your own ML programs. Be sure to load and run MetaBASIC *before* loading any other programs. *See program listing on page 141.*

NEWS & PRODUCTS

Tax Package For 64

The 1985 version of Arrays, Inc./ Continental Software's *The Tax Advantage* is now available for the 1984 tax year. The program aids in preparing forms 1040, 6251, 2106, 2441, and 4562, and schedules A, B, C, D, E, G, SE, and W.

It performs operations such as income averaging; itemizing wages, deductions, and assets; and computing the new alternate "minimum tax." The program is available on disk at a suggested price of $69.95.

Arrays, Inc./Continental Software, 11223 S. Hindry Ave., Los Angeles, CA 90045

Circle Reader Service Number 223.

Updated Typing Tutorial

Scarborough Systems, Inc. has released an updated version of its typing instruction program, called *New Improved Mastertype.* It's available on disk and cartridge for the Commodore 64 at a suggested retail price of $39.95.

The program teaches basic and advanced typing and keyboard skills by using a space-age game. Onscreen finger positioning, sentence and typing rhythm lessons, and improved accuracy and skill measurements have been added to the new version. The tutorial has 18 successive difficulty levels and is suitable for ages six to adult.

Scarborough Systems Inc., 25 N. Broadway, Tarrytown, NY 10591

Circle Reader Service Number 224.

Productivity Packages, Books For 64

Abacus Software has announced 13 new programs and books for the Commodore 64. The books are priced from around $15 each, while the software starts at $39.95.

New language and development software includes: *Ada Training Course, BASIC-64 Compiler, C Language Compiler, Fortran Compiler,* and *Video Basic Development.* New productivity packages are: *Cadpak-64* (design package); *Chartpak-64* (charting program); *Datamat-64* (data management program); and *Power Plan-64,* a spreadsheet with graphics. New book titles for the 64 are: *Cassette Book for C-64; More Tricks & Tips for C-64; Peeks and Pokes for C-64;* and *Turbo Pascal Training Guide.*

Abacus Software, 2201 Kalamazoo S.E., P.O. Box 7211, Grand Rapids, MI 49510

Circle Reader Service Number 225.

64 Productivity Software

Batteries Included has introduced *HomePak,* a package of three integrated programs for home use. Included is *HomeText,* a word processor; *HomeFind,* a data management system; and *HomeTerm,* a terminal communications program.

The programs can be used separately or together. Data stored in *HomeFind* can be integrated with letters produced with *HomeText,* and *HomeText* can be used to write reports based on information called up via *HomeTerm.* Suggested retail price is $49.95.

Batteries Included, 30 Mural St., Richmond Hill, Ontario, CANADA L4B 1B5.

Circle Reader Service Number 226.

Graphics, Chart Generator

Graph Now, a graphics and chart generator for the Commodore 64, has been released by Cardco, Inc., at a suggested retail price of $39.95.

The program can generate line and bar graphs as well as graphic art designs. Graphics are generated with *Paint Now,* which is included. Both programs are compatible with Cardco's word processor, *Write Now.*

Cardco, Inc., 300 S. Topeka, Wichita, KS 67202

Circle Reader Service Number 227.

Graphics Tablet For 64

Animation Station, a new graphics tablet for the Commodore 64 which features a printer/dump and built-in character set, has been introduced by Suncom.

Besides its use for graphics, *Animation Station* can also be utilized for writing. Included with the package is *DesignLab,* a color software program which has a built-in cut-and-paste feature which allows the user to electronically reposition elements on the screen.

Other software programs are available. Suggested retail price is $79.95.

Suncom, 260 Holbrook Dr., Wheeling, IL 60090

Circle Reader Service Number 228.

64 Construction Set

Adventure Construction Set, a program that allows one to four players to design graphics and text adventures, has been introduced by Electronic Arts. The suggested retail price for the Commodore 64 version is $50.

Three programs are contained on the disk: *Adventure Construction Set; Rivers of Light,* an adventure set in Egypt and the Near East during the dawn of man; and *Land of Adventuria,* an adventuring tutorial for novices which contains seven mini-adventures, each based on a theme or a different kind of game that can be created with the construction set. These adventures can be modified by the player to help learn how to build adventures with *ACS.*

Electronic Arts, 2755 Campus Dr., San Mateo, CA 94403

Circle Reader Service Number 229.

New Product releases are selected from submissions for reasons of timeliness, uniqueness, available space, and general interest. Readers should be aware that News & Products often contains an edited version of material submitted by vendors. We are unable to vouch for its accuracy at time of publication.

The Automatic Proofreader

"The Automatic Proofreader" will help you type in program listings from COMPUTE!'s Gazette without typing mistakes. It is a short error-checking program that hides itself in memory. When activated, it lets you know immediately after typing a line from a program listing if you have made a mistake. Please read these instructions carefully before typing any programs in COMPUTE!'s Gazette.

Preparing The Proofreader

1. Using the listing below, type in the Proofreader. The same program works on both the VIC-20 and Commodore 64. Be very careful when entering the DATA statements — don't type an l instead of a 1, an O instead of a 0, extra commas, etc.

2. SAVE the Proofreader on tape or disk at least twice *before running it for the first time.* This is very important because the Proofreader erases this part of itself when you first type RUN.

3. After the Proofreader is SAVEd, type RUN. It will check itself for typing errors in the DATA statements and warn you if there's a mistake. Correct any errors and SAVE the corrected version. Keep a copy in a safe place — you'll need it again and again, every time you enter a program from COMPUTE!'s Gazette.

4. When a correct version of the Proofreader is RUN, it activates itself. You are now ready to enter a program listing. If you press RUN/STOP-RESTORE, the Proofreader is disabled. To reactivate it, just type the command SYS 886 and press RETURN.

Using The Proofreader

All VIC and 64 listings in COMPUTE!'s Gazette now have a *checksum number* appended to the end of each line, for example ":rem 123". *Don't enter this statement when typing in a program.* It is just for your information. The rem makes the number harmless if someone does type it in. It will, however, use up memory if you enter it, and it will confuse the Proofreader, even if you entered the rest of the line correctly.

When you type in a line from a program listing and press RETURN, the Proofreader displays a number at the top of your screen. *This checksum number must match the checksum number in the printed listing.* If it doesn't, it means you typed the line differently than the way it is listed. Immediately recheck your typing. Remember, don't type the rem statement with the checksum number; it is published only so you can check it against the number which appears on your screen.

The Proofreader is not picky with spaces. It will not notice extra spaces or missing ones. This is for your convenience, since spacing is generally not important. But occasionally proper spacing *is* important, so be extra careful with spaces, since the Proofreader will catch practically everything else that can go wrong.

There's another thing to watch out for: if you enter the line by using abbreviations for commands, the checksum will not match up. But there is a way to make the Proofreader check it. After entering the line, LIST it. This eliminates the abbreviations. Then move the cursor up to the line and press RETURN. It should now match the checksum. You can check whole groups of lines this way.

Special Tape SAVE Instructions

When you're done typing a listing, you must disable the Proofreader before SAVEing the program on tape. Disable the Proofreader by pressing RUN/STOP-RESTORE (hold down the RUN/STOP key and sharply hit the RESTORE key). This procedure is not necessary for disk SAVEs, *but you must disable the Proofreader this way before a tape SAVE.*

SAVE to tape erases the Proofreader from memory, so you'll have to LOAD and RUN it again if you want to type another listing. SAVE to disk does not erase the Proofreader.

Since the Proofreader is a machine language program stored in the cassette buffer, it will be erased during a tape SAVE or LOAD. If you intend to type in a program in more than one sitting or wish to make a safety SAVE, follow this procedure:

1. LOAD and RUN the Proofreader.
2. Disable it by pressing RUN/STOP–RESTORE.
3. Type the following three lines in direct mode (without line numbers):

```
A$="PROOFREADER.T":B$="{10 SPACES}":FO
RX=1TO4:A$=A$+B$:NEXTX
FORX=886 TO 1018:A$=A$+CHR$(PEEK(X)):N
EXTX
OPEN1,1,1,A$:CLOSE1
```

After you type the last line, you will be asked to press RECORD and PLAY. We recommend you start at the beginning of a new tape.

You now have a new version of the Proofreader (PROOFREADER.T, as renamed in the above code). Turn your computer off and on, then LOAD the program you were working on. Put the cassette containing PROOFREADER.T into the tape unit and type:

OPEN1:CLOSE1

You can now get into the Proofreader by typing SYS 886. To test this, PRINT PEEK (886) should return the number 173. If it does not, repeat the steps above, making sure that A$ (PROOFREADER.T) contains 13 characters and that B$ contains 10 spaces.

The new version of Automatic Proofreader will load itself into the cassette buffer whenever you type OPEN1:CLOSE1 and PROOFREADER.T is the next program on your tape. It will not disturb the contents of BASIC memory.

Automatic Proofreader For VIC And 64

```
100 PRINT"{CLR}PLEASE WAIT...":FORI=886TO
    1018:READA:CK=CK+A:POKEI,A:NEXT
110 IF CK<>17539 THEN PRINT"{DOWN}YOU MAD
    E AN ERROR":PRINT"IN DATA STATEMENTS.
    ":END
120 SYS886:PRINT"{CLR}{2 DOWN}PROOFREADER
     ACTIVATED.":NEW
886 DATA 173,036,003,201,150,208
892 DATA 001,096,141,151,003,173
898 DATA 037,003,141,152,003,169
904 DATA 150,141,036,003,169,003
910 DATA 141,037,003,169,000,133
916 DATA 254,096,032,087,241,133
922 DATA 251,134,252,132,253,008
928 DATA 201,013,240,017,201,032
934 DATA 240,005,024,101,254,133
940 DATA 254,165,251,166,252,164
946 DATA 253,040,096,169,013,032
952 DATA 210,255,165,214,141,251
958 DATA 003,206,251,003,169,000
964 DATA 133,216,169,019,032,210
970 DATA 255,169,018,032,210,255
976 DATA 169,058,032,210,255,166
982 DATA 254,169,000,133,254,172
988 DATA 151,003,192,087,208,006
994 DATA 032,205,189,076,235,003
1000 DATA 032,205,221,169,032,032
1006 DATA 210,255,032,210,255,173
1012 DATA 251,003,133,214,076,173
1018 DATA 003
```

NoZap

(Article on page 110.)

BEFORE TYPING . . .

Before typing in programs, please refer to "How To Type In COMPUTE!'s GAZETTE Programs," which appears before the Program Listings.

Program 1: NoZap—VIC Version

```
2 POKE56,PEEK(56)-1:CLR:I=256*PEEK(56)+PE
  EK(55):S=I                          :rem 216
4 DEFFNH(X)=INT(X/256)                 :rem 37
6 DEFFNL(X)=X-FNH(X)*256               :rem 156
8 DATA169,141,141,161,0,96,76          :rem 202
10 FORJ=739TO745:READK:POKEJ,K:NEXT
                                       :rem 249
12 POKE746,PEEK(55):POKE747,PEEK(56)
                                       :rem 87
14 PRINT "SYS 739=FORCED SAVE.{2 SPACES}S
   YS 745=TOGGLE."                     :rem 241
16 READ A:B=B+A:IF A=256 THEN 102:rem 209
18 POKE I,A:I=I+1:GOTO 16              :rem 141
20 DATA 173,236,2,73,1,141             :rem 241
22 DATA 236,2,208,13,169,131           :rem 90
24 DATA 141,2,3,169,196,141            :rem 45
26 DATA 3,3,76,131,196,169             :rem 6
28 DATA 48,141,239,2,141,240           :rem 94
30 DATA 2,169,7,160,7,32               :rem 149
32 DATA 30,203,32,249,203,160          :rem 131
34 DATA 2,185,254,1,153,239            :rem 48
36 DATA 2,240,3,200,208,245            :rem 33
38 DATA 140,237,2,162,7,160            :rem 43
40 DATA 7,142,2,3,140,3                :rem 85
42 DATA 3,169,1,141,238,2:REM CHANGE THE
   {SPACE}1 FOR A LONGER INTERVAL:rem 239
44 DATA 169,0,133,160,133,161          :rem 139
46 DATA 133,162,165,161,56,201         :rem 194
48 DATA 141,144,116,206,238,2          :rem 144
50 DATA 208,236,238,240,2,173          :rem 144
52 DATA 240,2,201,58,208,20            :rem 33
54 DATA 169,48,141,240,2,238           :rem 102
56 DATA 239,2,173,239,2,201            :rem 47
58 DATA 58,208,5,169,48,141            :rem 65
60 DATA 239,2,173,237,2,162            :rem 46
62 DATA 239,160,2,32,189,255           :rem 104
64 DATA 169,1,162,8,160,0              :rem 201
66 DATA 32,186,255,169,43,166          :rem 166
68 DATA 45,164,46,32,216,255           :rem 108
70 DATA 169,141,32,210,255,169         :rem 199
72 DATA 0,32,189,255,169,15            :rem 56
74 DATA 162,8,168,32,186,255           :rem 113
76 DATA 32,192,255,162,15,32           :rem 100
78 DATA 198,255,32,207,255,201         :rem 208
80 DATA 13,240,6,32,210,255            :rem 34
82 DATA 56,176,243,32,210,255          :rem 150
84 DATA 169,15,32,195,255,32           :rem 109
86 DATA 204,255,76,7,7,76              :rem 222
88 DATA 131,196,18,78,79,90            :rem 76
90 DATA 65,80,146,32,66,89             :rem 15
92 DATA 32,66,76,65,75,69              :rem 229
94 DATA 32,76,65,77,66,69              :rem 233
96 DATA 82,84,13,70,73,76              :rem 221
98 DATA 69,78,65,77,69,0,256           :rem 134
102 IF B<>28586THENPRINT"ERROR IN DATA ST
    ATEMENTS.":END                     :rem 109
104 POKE S+32,FNL(S+206):POKES+34,FNH(S+2
    06)                                :rem 215
106 POKE S+58,FNL(S+80):POKES+60,FNH(S+80
    )                                  :rem 128
108 POKE S+201,FNL(S+67):POKES+202,FNH(S+
    67)                                :rem 224
110 SYS745                             :rem 49
```

Program 2: NoZap—64 Version

```
2 POKE56,PEEK(56)-1:CLR:I=256*PEEK(56)+PE
  EK(55):S=I                          :rem 216
4 DEFFNH(X)=INT(X/256)                 :rem 37
6 DEFFNL(X)=X-FNH(X)*256               :rem 156
8 DATA169,16,141,10,220,96,76          :rem 200
10 FORJ=739TO745:READK:POKEJ,K:NEXT
                                       :rem 249
12 POKE746,PEEK(55):POKE747,PEEK(56)
                                       :rem 87
14 PRINT "SYS 739=FORCED SAVE. SYS 745=TO
   GGLE."                              :rem 241
16 READ A:B=B+A:IF A=256 THEN 102:rem 209
18 POKE I,A:I=I+1:GOTO 16              :rem 141
20 DATA 173,236,2,73,1,141             :rem 241
22 DATA 236,2,208,13,169,131           :rem 90
24 DATA 141,2,3,169,164,141            :rem 40
26 DATA 3,3,76,131,164,169             :rem 1
28 DATA 48,141,239,2,141,240           :rem 94
30 DATA 2,169,7,160,7,32               :rem 149
32 DATA 30,171,32,249,171,160          :rem 139
34 DATA 2,185,254,1,153,239            :rem 48
36 DATA 2,240,3,200,208,245            :rem 33
38 DATA 140,237,2,162,7,160            :rem 43
40 DATA 7,142,2,3,140,3                :rem 85
42 DATA 3,169,1,141,238,2:REM CHANGE THE
   {SPACE}1 FOR A LONGER INTERVAL:rem 239
44 DATA 169,0,141,8,220,141            :rem 38
46 DATA 9,220,141,10,220,173           :rem 83
48 DATA 10,220,41,240,240,117          :rem 129
50 DATA 206,238,2,208,233,238          :rem 145
52 DATA 240,2,173,240,2,201            :rem 27
54 DATA 58,208,20,169,48,141           :rem 106
56 DATA 240,2,238,239,2,173            :rem 49
58 DATA 239,2,201,58,208,5             :rem 2
60 DATA 169,48,141,239,2,173           :rem 105
62 DATA 237,2,162,239,160,2            :rem 44
64 DATA 32,189,255,169,1,162           :rem 109
66 DATA 8,160,0,32,186,255             :rem 1
68 DATA 169,43,166,45,164,46           :rem 118
70 DATA 32,216,255,169,141,32          :rem 146
72 DATA 210,255,169,0,32,189           :rem 101
74 DATA 255,169,15,162,8,160           :rem 107
76 DATA 15,32,186,255,32,192           :rem 106
78 DATA 255,162,15,32,198,255          :rem 163
80 DATA 32,207,255,201,13,240          :rem 133
82 DATA 6,32,210,255,56,176            :rem 51
84 DATA 243,32,210,255,169,15          :rem 149
86 DATA 32,195,255,32,204,255          :rem 155
88 DATA 76,7,7,76,131,164              :rem 222
90 DATA 18,78,79,90,65,80              :rem 227
92 DATA 146,32,66,89,32,66             :rem 15
94 DATA 76,65,75,69,32,76              :rem 232
96 DATA 65,77,66,69,82,84              :rem 239
98 DATA 13,70,73,76,69,78              :rem 231
100 DATA 65,77,69,0,256                :rem 112
102 IF B<>28715THENPRINT"ERROR IN DATA SA
    TEMENTS.":END                      :rem 19
104 POKE S+32,FNL(S+210):POKES+34,FNH(S+2
    10)                                :rem 205
106 POKE S+58,FNL(S+83):POKES+60,FNH(S+83
    )                                  :rem 134
108 POKE S+205,FNL(S+67):POKES+206,FNH(S+
    67)                                :rem 232
110 SYS745                             :rem 49
```

Pool

(Article on page 50.)

BEFORE TYPING . . .

Before typing in programs, please refer to "How To Type In COMPUTE!'s GAZETTE Programs," which appears before the Program Listings.

Program 1: VIC Version

```
14 POKE36879,10:PRINT"{CLR}{YEL}":rem 110
16 PRINT"FIRST PLAYER NAME."      :rem 220
18 PRINT:INPUTN$                   :rem 50
20 A$=LEFT$(N$,7)                 :rem 121
22 PRINT: PRINT:PRINT"SECOND PLAYER NAME.
   "                              :rem 155
24 PRINT:INPUTN$                   :rem 47
26 B$=LEFT$(N$,7)                 :rem 128
28 PRINT"{CLR}"                   :rem 206
30 D=1:Q0=7981:B0=87:B1=81:B=B0:C=1
                                  :rem 167
40 POKE37154,127:POKE36878,15     :rem 104
70 FORP=38511TO38863STEP22         :rem 44
80 FORZ=0TO19                      :rem 35
90 POKEP+Z,7                      :rem 208
100 NEXTZ:NEXTP                   :rem 243
110 B=B0:Q=Q0                     :rem 204
120 POKEQ,B                       :rem 129
130 GOSUB3030                     :rem 218
500 REM PLAY                      :rem 175
510 IFD=1THENGOSUB1000             :rem 71
520 GOSUB2500                     :rem 222
530 IFPEEK(Q+I)<>32THENGOSUB2000  :rem 178
540 IFPEEK(Q+I)<>32THENGOSUB2500  :rem 184
545 IFPEEK(Q+I)<>32THENGOSUB2000  :rem 184
550 POKEQ,32                      :rem 171
560 Q=Q+I                         :rem 238
565 IFB=B0THENQC=Q                :rem 113
570 POKEQ,B                       :rem 138
580 IFI=0THEN510                  :rem 167
590 FORT=0TOD:NEXTT               :rem 250
600 D=D*1.2                        :rem 22
610 IFD>200THENI=0:D=1:H=0:IFB=B1THENB=B0
    :Q=QC:POKEQ,B                  :rem 89
620 IFD=1THENGOSUB3007             :rem 82
630 GOTO510                       :rem 104
1000 REM CUE CONTROL              :rem 163
1005 REM AIM                      :rem 129
1010 IFS=1THENGOSUB6000           :rem 135
1020 FORV=1TO8                     :rem 73
1030 IFV=1THENI=-1:Z=67           :rem 104
1040 IFV=2THENI=-23:Z=77          :rem 159
1050 IFV=3THENI=-22:Z=93          :rem 158
1060 IFV=4THENI=-21:Z=78          :rem 162
1070 IFV=5THENI=1:Z=67             :rem 67
1080 IFV=6THENI=23:Z=77           :rem 122
1090 IFV=7THENI=22:Z=93           :rem 121
1100 IFV=8THENI=21:Z=78           :rem 116
1110 A=PEEK(Q-I)                  :rem 126
1120 POKEQ-I,Z                     :rem 64
1130 FORT=0TO100:NEXTT            :rem 110
1140 POKEQ-I,A                     :rem 41
1150 GOSUB7000                     :rem 14
1160 IFJ=0ANDK=64THEN1110         :rem 197
1170 IFJ=32ORK=39THEN1200         :rem 203
1180 NEXTV                         :rem 95
1190 GOTO1000                     :rem 197
1200 REM BALL SPEED                :rem 51
1210 FORD=1TO100STEP10             :rem 46
1220 V$=STR$(100-(D-1))           :rem 155
1240 PRINT"{HOME}{2 DOWN}SPEED";V$+" "
                                   :rem 98
1260 FORT=0TO300:NEXTT            :rem 116
1280 GOSUB7000                     :rem 18
1300 IFJ=0ANDK=64THEN5000         :rem 195
1310 NEXTD                         :rem 72
1320 GOTO1200                     :rem 194
2000 REM BOUNDARIES               :rem 146
2010 IFPEEK(Q+I)=102THENH=1:GOTO3000
                                  :rem 120
2020 IFPEEK(Q+22)=102THENH=1:GOTO3000
                                  :rem 148
2030 IFPEEK(Q-22)=102THENH=1:GOTO3000
                                  :rem 151
2040 IFPEEK(Q+I)=100THENI=I+44:GOTO5000
                                   :rem 39
2050 IFPEEK(Q+I)=99THENI=I-44:GOTO5000
                                   :rem 11
2060 IFPEEK(Q+I)=103THENI=I+2:GOTO5000
                                  :rem 246
2070 IFPEEK(Q+I)=101THENI=I-2:GOTO5000
                                  :rem 247
2080 RETURN                       :rem 170
2500 REM BALL COLLISION           :rem 114
2510 IFI=0THENRETURN               :rem 28
2520 IFPEEK(Q+I)=B0THENPOKEQ,B:B=B0:Q=Q+I
    :GOTO5000                      :rem 79
2530 IFPEEK(Q+I)=B1THENPOKEQ,B:B=B1:Q=Q+I
    :GOTO5000                      :rem 82
2540 IFPEEK(Q+1)=B1THENPOKEQ,B:B=B1:Q=Q+1
    :GOTO5000                      :rem 35
2550 IFPEEK(Q-1)=B1THENPOKEQ,B:B=B1:Q=Q-1
    :GOTO5000                      :rem 40
2560 IFPEEK(Q-22)=B1THENPOKEQ,B:B=B1:Q=Q-
    22:GOTO5000                   :rem 143
2570 IFPEEK(Q+22)=B1THENPOKEQ,B:B=B1:Q=Q+
    22:GOTO5000                   :rem 140
2580 RETURN                       :rem 175
3000 REM SCORING                  :rem 188
3005 IFB=B0THENI=0:D=1:POKEQ,32:Q=Q0:H=0:
    S=1                           :rem 151
3007 IFH=0THENC=-C:GOSUB5400      :rem 176
3010 IFC<0THEN3500                :rem 249
3020 IFH=1THENSA=SA+1:POKEQ,32:GOSUB5200
                                  :rem 198
3030 PRINT"{HOME}{RVS}"A$;SA"{OFF}";TAB(1
    1)B$;SB                       :rem 193
3040 IFB=B1THENH=0:I=0:D=1:Q=QC:B=B0
                                  :rem 143
3045 PRINT"{HOME}{2 DOWN}SPEED 100"
                                  :rem 212
3050 FORP=7768TO8183              :rem 143
3060 IFPEEK(P)=B1THENRETURN       :rem 221
3070 NEXTP                         :rem 89
3080 GOSUB4000                     :rem 15
3090 RETURN                       :rem 172
3500 IFH=1THENSB=SB+1:POKEQ,32:GOSUB5200
                                  :rem 203
3510 PRINT"{HOME}"A$;SA;TAB(11)"{RVS}
    {CYN}"B$;SB"{OFF}{YEL}"        :rem 69
3535 IFSA+SB=15THEN9000            :rem 78
3540 GOTO3040                     :rem 204
4000 REM SET TABLE                :rem 252
4100 FORP=7770TO7777:POKEP,100:NEXT
                                  :rem 124
4106 FORP=7780TO7787:POKEP,100:NEXT
                                  :rem 132
4120 FORP=8166TO8173:POKEP,99:NEXT:rem 86
```

```
4126 FORP=8176TO8183:POKEP,99:NEXT:rem 94
4160 FORP=7812TO8120STEP22:POKEP,103:NEXT
                                   :rem 17
4190 FORP=7833TO8141STEP22:POKEP,101:NEXT
                                   :rem 24
4220 POKE7768,102:POKE7769,102:POKE7790,1
     02                            :rem 150
4230 POKE8164,102:POKE8165,102:POKE8142,1
     02                            :rem 125
4240 POKE7789,102:POKE7788,102:POKE7811,1
     02                            :rem 150
4250 POKE8185,102:POKE8184,102:POKE8163,1
     02                            :rem 134
4260 POKE7778,102:POKE7779,102     :rem 157
4270 POKE8174,102:POKE8175,102     :rem 140
4300 FORN=1TO15                    :rem 115
4310 P=7768+INT(396*RND(0))        :rem 201
4320 IFPEEK(P)<>32THEN4310         :rem 244
4330 IFPEEK(P+1)<>32THEN4310        :rem 81
4340 IFPEEK(P-1)<>32THEN4310        :rem 84
4350 IFPEEK(P+22)<>32THEN4310      :rem 134
4360 IFPEEK(P-22)<>32THEN4310      :rem 137
4370 IFPEEK(P+21)<>32THEN4310      :rem 135
4380 IFPEEK(P-21)<>32THEN4310      :rem 138
4390 IFPEEK(P+23)<>32THEN4310      :rem 139
4400 IFPEEK(P-23)<>32THEN4310      :rem 133
4410 POKEP,B1                      :rem 231
4420 NEXTN                          :rem 87
4430 RETURN                        :rem 171
5000 REM BUMP SOUND                :rem 102
5005 D=D*1.2                        :rem 74
5010 POKE36875,180                 :rem 199
5020 FORT=0TO10:NEXTT               :rem 64
5030 POKE36875,0                    :rem 96
5040 RETURN                        :rem 169
5200 REM SCORE SOUND               :rem 176
5210 FORS=0TO2                      :rem 68
5220 POKE36876,220                 :rem 198
5230 FORT=0TO20:NEXTT               :rem 68
5240 POKE36876,0                   :rem 100
5245 FORT=0TO20:NEXTT               :rem 74
5247 IFSA+SB=15THEN9000             :rem 80
5250 NEXTS                          :rem 94
5260 RETURN                        :rem 173
5400 REM TURNOVER SOUND            :rem 187
5410 POKE36875,135                 :rem 203
5420 POKE36874,201                 :rem 197
5430 FORT=0TO500:NEXTT             :rem 121
5440 POKE36875,0                   :rem 101
5450 POKE36874,0                   :rem 101
5460 RETURN                        :rem 175
6000 REM SCRATCH                   :rem 178
6005 REM DRAW LINE                   :rem 5
6010 FORP=7782TO8156STEP22          :rem 42
6020 IFPEEK(P)=32THENPOKEP,103      :rem 45
6030 NEXTP                          :rem 88
6035 REM MOVE CUEBALL              :rem 225
6040 V=1                           :rem 142
6500 GOSUB7000                      :rem 18
6505 IFJ=0ANDK=64THEN6500          :rem 213
6510 IFJ=4ORJ=8ORK=47THENI=V*22     :rem 163
6520 IFJ=1ORJ=16ORK=55THENI=V*1     :rem 156
6530 IFPEEK(Q+I)<>32THENV=-V:I=-I:rem 242
6535 IFJ=32ORK=39THEN6580          :rem 229
6540 POKEQ,32:Q=Q+I:QC=Q           :rem 201
6550 POKEQ,B                       :rem 190
6570 GOTO6500                      :rem 214
6580 GOSUB7000                      :rem 26
6590 IFJ=0ANDK=64THEN6600          :rem 218
6595 GOTO6580                      :rem 229
6600 REM ERASE LINE                  :rem 72
6605 FORP=7782TO8156STEP22           :rem 52
6610 IFPEEK(P)=103THENPOKEP,32       :rem 50
6620 NEXTP                           :rem 93
6630 S=0                            :rem 143
6640 RETURN                         :rem 176
7000 REM READ JOYSTICK               :rem 55
7010 J=(NOTPEEK(37151))AND60-((PEEK(37152
     )AND128)=0)                     :rem 99
7020 K=PEEK(197)                    :rem 104
7030 RETURN                         :rem 170
9000 PRINT"{CLR}{5 DOWN}{5 SPACES}PLAY AG
     AIN?":POKE198,0:PRINT"{2 DOWN}
     {8 SPACES}(Y/N)"                :rem 18
9010 GETA$:IFA$="Y"THENRUN           :rem 59
9020 IFA$<>"N"THEN9010              :rem 196
```

Program 2: 64 Version

```
49152 :169,012,141,021,208,169,208
49158 :255,141,059,099,141,060,249
49164 :099,169,001,141,001,088,255
49170 :169,000,141,051,099,032,254
49176 :024,197,032,206,203,169,087
49182 :255,141,021,208,032,209,128
49188 :195,032,093,197,032,163,236
49194 :197,032,248,204,169,000,124
49200 :141,062,099,141,063,099,141
49206 :173,001,088,208,115,162,033
49212 :000,142,057,099,189,004,039
49218 :208,201,070,240,006,201,224
49224 :235,240,008,208,097,238,074
49230 :062,099,076,086,192,238,063
49236 :063,099,232,232,224,012,178
49242 :208,228,162,022,160,012,114
49248 :024,032,240,255,173,058,110
49254 :099,201,001,208,003,076,178
49260 :027,206,173,062,099,205,112
49266 :063,099,240,036,176,017,233
49272 :169,238,160,204,032,030,185
49278 :171,169,184,160,205,032,023
49284 :030,171,076,161,192,169,163
49290 :227,160,204,032,030,171,194
49296 :169,184,160,205,032,030,156
49302 :171,076,161,192,169,171,066
49308 :160,205,032,030,171,169,155
49314 :060,133,162,165,161,197,016
49320 :161,240,252,076,000,192,065
49326 :173,001,088,240,003,032,199
49332 :010,195,169,000,141,001,184
49338 :088,141,061,099,032,226,065
49344 :192,169,000,141,164,096,186
49350 :141,032,096,141,000,088,184
49356 :032,042,193,162,009,032,162
49362 :112,193,202,208,250,032,183
49368 :118,193,173,000,088,240,004
49374 :226,076,043,192,173,002,166
49380 :208,141,000,208,201,175,137
49386 :144,004,169,254,208,003,248
49392 :024,105,080,141,053,099,230
49398 :173,000,208,056,233,080,228
49404 :141,054,099,173,003,208,162
49410 :141,001,208,201,165,144,094
49416 :004,169,245,208,003,024,149
49422 :105,080,141,056,099,173,156
49428 :057,099,208,017,173,001,063
49434 :208,201,130,176,004,169,146
49440 :050,208,003,056,233,080,150
49446 :141,055,099,096,174,000,091
49452 :208,172,051,099,185,000,247
49458 :220,172,001,208,074,176,133
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49464 :007,136,204,055,099,176,221
49470 :001,200,074,176,007,200,208
49476 :204,056,099,144,001,136,196
49482 :074,176,007,202,236,054,055
49488 :099,176,001,232,074,176,070
49494 :007,232,236,053,099,144,089
49500 :001,202,074,176,008,169,210
49506 :001,141,032,096,141,000,253
49512 :088,142,000,208,140,001,171
49518 :208,096,160,000,136,208,150
49524 :253,096,173,032,096,208,206
49530 :003,076,143,194,169,000,195
49536 :141,112,096,141,096,096,042
49542 :173,000,208,056,237,002,042
49548 :208,046,112,096,141,000,231
49554 :096,173,001,208,056,237,149
49560 :003,208,046,096,096,141,230
49566 :016,096,173,112,096,208,091
49572 :011,173,000,096,073,255,004
49578 :141,000,096,238,000,096,229
49584 :169,004,141,128,096,173,119
49590 :096,096,208,011,173,016,014
49596 :096,073,255,141,016,096,097
49602 :238,016,096,160,000,185,121
49608 :112,096,240,028,185,000,093
49614 :101,024,121,000,096,153,189
49620 :000,101,185,002,208,105,045
49626 :000,201,198,144,003,032,028
49632 :144,194,153,002,208,076,233
49638 :001,194,185,000,101,056,255
49644 :249,000,096,153,000,101,067
49650 :185,002,208,233,000,201,047
49656 :106,176,003,032,144,194,135
49662 :153,002,208,185,096,096,226
49668 :240,028,185,032,101,024,102
49674 :121,016,096,153,032,101,017
49680 :185,003,208,105,000,201,206
49686 :194,144,003,032,181,194,002
49692 :153,003,208,076,059,194,209
49698 :185,032,101,056,249,016,161
49704 :096,153,032,101,185,003,098
49710 :208,233,000,201,090,176,186
49716 :003,032,181,194,153,003,106
49722 :208,032,199,197,172,162,004
49728 :096,200,200,192,014,240,238
49734 :003,076,199,193,202,240,215
49740 :003,076,197,193,206,128,111
49746 :096,208,248,032,065,205,168
49752 :169,004,141,128,096,162,020
49758 :012,189,000,096,029,016,180
49764 :096,201,006,176,228,169,208
49770 :000,157,000,096,157,016,020
49776 :096,202,202,016,234,169,007
49782 :000,141,032,096,162,014,051
49788 :157,000,096,157,016,096,134
49794 :202,016,247,173,061,099,160
49800 :208,005,169,001,141,001,149
49806 :088,096,072,032,190,205,057
49812 :162,001,185,112,096,073,009
49818 :001,153,112,096,185,003,192
49824 :208,201,192,176,043,201,157
49830 :093,144?,039,201,138,176,189
49836 :002,104,096,201,146,144,097
49842 :029,104,096,072,032,190,189
49848 :205,162,000,185,096,096,160
49854 :073,001,153,096,096,185,026
49860 :002,208,201,195,176,006,216
49866 :201,107,144,002,104,096,088
49872 :032,208,205,104,192,000,181
49878 :208,007,169,001,141,001,229
49884 :088,208,003,238,164,096,249
49890 :169,000,153,000,096,153,029
49896 :016,096,173,051,099,240,139
49902 :004,169,070,208,002,169,092
49908 :235,153,002,208,152,010,236
49914 :010,010,024,105,070,153,110
49920 :003,208,224,000,240,003,166
49926 :185,002,208,096,169,254,152
49932 :141,021,208,173,058,099,200
49938 :201,001,240,007,173,051,179
49944 :099,073,001,240,004,169,098
49950 :070,208,002,169,235,162,108
49956 :000,221,004,208,240,009,206
49962 :232,232,224,014,208,245,173
49968 :076,096,195,169,155,157,128
49974 :004,208,232,169,148,157,204
49980 :004,208,254,004,208,165,135
49986 :162,197,162,240,252,165,220
49992 :162,197,162,240,252,173,234
49998 :030,208,208,236,254,004,250
50004 :208,165,162,197,162,240,194
50010 :252,173,030,208,208,222,159
50016 :169,153,141,002,208,170,171
50022 :169,100,141,003,208,141,096
50028 :057,099,165,162,197,162,182
50034 :240,252,172,051,099,185,089
50040 :000,220,142,002,208,074,254
50046 :176,017,206,003,208,072,040
50052 :173,003,208,201,090,176,215
50058 :005,169,100,141,003,208,252
50064 :104,074,074,176,006,202,012
50070 :224,105,176,001,232,074,194
50076 :176,006,232,224,199,144,113
50082 :001,202,074,176,199,165,211
50088 :162,197,162,240,252,173,074
50094 :030,208,041,002,208,186,081
50100 :185,000,220,041,016,240,114
50106 :249,169,000,133,162,105,236
50112 :025,197,162,176,252,169,149
50118 :255,141,021,208,173,003,231
50124 :208,141,055,099,096,169,204
50130 :147,032,210,255,169,160,159
50136 :160,016,153,130,004,153,064
50142 :170,004,169,160,153,002,112
50148 :007,153,042,007,136,016,077
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52860 :065,077,065,084,069,085,057
52866 :082,000,089,079,085,039,248
52872 :082,069,032,065,032,080,240
52878 :079,079,076,032,083,072,051
52884 :065,082,075,000,029,029,172
52890 :029,089,079,085,039,082,045
52896 :069,032,065,032,080,082,008
52902 :079,000,013,013,013,013,041
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Astro-PANIC! For The VIC

(Article on page 58.)

BEFORE TYPING . . .

Before typing in programs, please refer to "How To Type In COMPUTE!'s GAZETTE Programs," which appears before the Program Listings.

VIC MLX is required to enter this program.

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4608 :162,000,189,074,003,201,117
4614 :094,144,003,076,106,019,192
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4626 :003,016,021,010,133,174,119
4632 :056,189,068,003,229,174,231
4638 :157,068,003,176,020,222,164
4644 :066,003,076,055,018,234,232
4650 :010,024,125,068,003,157,173
4656 :068,003,144,003,254,066,074
4662 :003,134,174,234,189,066,086
4668 :003,201,001,144,007,201,105
4674 :166,176,059,076,192,018,241
4680 :032,148,224,166,174,165,213
4686 :141,157,070,003,169,127,233
4692 :157,071,003,165,143,048,159
4698 :024,234,234,234,165,142,099
4704 :041,128,029,071,003,157,013
4710 :071,003,094,070,003,169,000
4716 :001,157,066,003,076,192,091
4722 :018,094,070,003,094,071,208
4728 :003,076,091,018,234,234,008
4734 :234,234,032,148,224,166,140
4740 :174,165,141,157,070,003,074
4746 :169,127,157,071,003,165,062
4752 :143,048,029,169,128,094,243
4758 :070,003,029,070,003,157,226
4764 :070,003,165,142,041,128,193
4770 :029,071,003,157,071,003,240
4776 :169,166,157,066,003,076,037
4782 :192,018,094,070,003,094,133
4788 :071,003,076,147,018,234,217
4794 :234,234,234,234,234,234,054
4800 :189,071,003,016,021,010,246
4806 :133,174,056,189,069,003,054
4812 :229,174,157,069,003,176,244
4818 :020,222,067,003,076,231,061
4824 :018,234,010,024,125,069,184
4830 :003,157,069,003,144,003,089
4836 :254,067,003,134,174,234,070
4842 :189,067,003,201,003,144,073
4848 :007,201,150,176,059,076,141
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4860 :174,165,141,157,071,003,195
4866 :169,127,157,070,003,165,181
4872 :143,048,024,234,234,234,157
4878 :165,142,041,128,029,070,077
4884 :003,157,070,003,094,071,162
4890 :003,169,003,157,067,003,172
4896 :076,106,019,094,071,003,145
4902 :094,070,003,076,014,019,058
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4914 :224,166,174,165,141,157,053
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4926 :003,165,143,048,029,169,107
4932 :128,094,071,003,029,071,208
4938 :003,157,071,003,165,142,103
4944 :041,128,029,070,003,157,252
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5082 :076,016,020,189,074,003,084
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5094 :076,016,020,234,238,192,238
5100 :003,173,192,003,205,193,237
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5274 :177,176,133,188,032,000,092
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5292 :160,001,177,176,133,188,239
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5592 :076,160,023,234,234,234,153
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5604 :170,224,083,144,192,234,251
5610 :234,234,234,234,234,234,102
5616 :096,234,234,234,234,234,226
5622 :234,234,234,234,234,234,114
5628 :234,234,234,234,234,234,120
5634 :234,234,234,234,234,234,126
5640 :234,234,234,234,234,234,132
5646 :234,234,173,160,003,201,251
5652 :001,208,105,172,166,003,163
5658 :173,164,003,133,251,173,155
5664 :165,003,133,252,169,032,018
5670 :145,251,056,173,164,003,062
5676 :233,022,176,003,206,165,081
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5838 :128,136,192,255,208,251,096
5844 :202,224,255,208,244,173,238
5850 :195,003,024,105,176,141,094
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5946 :169,096,157,074,003,141,186
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5958 :101,179,133,179,105,008,007
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5970 :003,166,253,076,058,020,146
5976 :234,234,234,234,234,234,212
5982 :234,234,162,000,169,000,125
5988 :157,082,027,169,048,157,228
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6030 :234,234,173,194,003,201,157
6036 :001,240,003,076,000,024,236
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6132 :234,234,234,234,234,234,112
6138 :234,234,234,234,234,234,118
6144 :173,060,003,074,074,074,202
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6162 :006,206,060,003,206,060,047
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6186 :032,240,027,173,060,003,065
6192 :201,000,208,005,169,002,121
6198 :141,060,003,173,060,003,238
6204 :201,166,208,005,169,164,205
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6366 :229,026,169,144,141,020,183
6372 :003,169,023,141,021,003,076
6378 :169,159,141,014,144,169,006
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6390 :169,000,157,068,027,232,131
6396 :224,014,208,248,169,003,094
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6408 :210,255,169,000,141,193,208
6414 :003,169,080,141,060,003,214
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6474 :027,221,074,027,240,005,156
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6768 :190,255,000,255,000,255,043
6774 :000,000,064,255,000,255,180
6780 :000,000,255,255,162,000,028
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6834 :141,170,003,206,195,003,128
6840 :173,195,003,201,000,240,228
6846 :038,169,001,141,194,003,224
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6876 :000,141,194,003,076,000,122
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6924 :234,234,234,234,234,234,136
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7122 :032,018,030,032,032,080,178
7128 :082,069,083,083,032,065,118
7134 :078,089,032,075,069,089,142
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7146 :073,071,072,032,083,067,120
7152 :079,082,069,058,005,000,021
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7188 :168,255,000,255,000,255,185
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7212 :255,250,251,255,255,083,113
7218 :255,166,000,252,255,255,209
7224 :255,000,000,255,255,000,053
7230 :255,255,168,255,000,000,227
7236 :255,170,255,000,255,255,234
7242 :162,004,255,255,255,255,236
7248 :255,255,255,000,255,255,075
7254 :255,255,255,255,255,255,080
7260 :255,255,004,191,000,255,028
7266 :255,255,255,255,255,255,092
7272 :255,255,000,128,255,255,228
7278 :255,255,191,085,255,255,126
7284 :000,238,000,255,230,171,242
7290 :255,255,168,255,255,255,029
7296 :000,008,252,004,000,000,136
7302 :255,000,255,000,255,187,062
7308 :000,000,220,000,000,255,103
7314 :255,020,008,020,000,000,193
7320 :000,000,000,000,000,064,216
7326 :000,000,020,000,084,255,005
7332 :000,004,255,255,000,000,166
7338 :000,000,000,136,000,000,050
7344 :000,000,000,020,000,000,196
7350 :000,000,000,020,000,000,202
7356 :000,064,000,000,000,000,252
7362 :255,255,020,000,000,000,212
7368 :129,000,255,255,068,255,138
7374 :238,239,000,136,168,255,218
7380 :255,000,000,000,132,255,086
7386 :000,255,255,016,220,040,236
7392 :000,000,000,255,000,084,051
7398 :000,000,008,128,000,020,130
7404 :034,000,000,085,000,000,099
7410 :000,255,000,213,213,064,219
7416 :000,008,255,255,213,000,211
7422 :255,255,000,000,000,000,252
7428 :000,000,000,000,000,008,012
7434 :028,062,062,042,000,000,204
7440 :012,012,063,063,251,217,122
7446 :217,200,000,000,000,000,183
7452 :192,192,192,192,012,063,103
7458 :085,136,136,085,063,012,039
7464 :000,000,064,128,128,064,168
7470 :000,000,003,015,021,034,119
7476 :034,021,015,003,000,192,061
7482 :080,032,032,080,192,000,218
7488 :000,003,005,008,008,005,093
7494 :003,000,192,240,084,136,213
7500 :136,084,240,192,000,000,216
7506 :001,002,002,001,000,000,088
7512 :048,252,085,034,034,085,114
7518 :252,048,160,042,043,175,046
7524 :047,171,042,008,160,168,184
7530 :234,248,250,224,168,032,238
7536 :130,034,042,175,043,010,034
7542 :042,136,002,136,160,170,252
7548 :232,170,168,034,032,002,250
7554 :136,043,142,034,128,034,135
7560 :130,008,136,176,130,032,236
7566 :044,002,032,003,000,003,226
7572 :162,000,048,008,032,000,142
7578 :002,136,000,050,128,004,218
7584 :000,000,000,000,000,000,160
7590 :000,000,000,000,000,000,166
7596 :000,000,000,000,000,000,172
7602 :000,020,000,000,000,000,198
7608 :000,004,000,000,000,064,252
7614 :000,000,000,000,245,255,178
7620 :004,000,000,000,129,000,073
7626 :255,255,068,255,174,239,168
7632 :000,000,004,255,253,000,208
7638 :000,000,164,255,000,255,120
7644 :255,016,149,032,002,001,163
7650 :002,001,002,001,002,001,235
7656 :192,128,192,128,192,128,168
7662 :192,128,000,000,000,255,045
7668 :000,213,213,064,000,000,222
7674 :255,255,149,000,255,255,139
```

Apple Hunt

(Article on page 54.)

BEFORE TYPING . . .

Before typing in programs, please refer to "How To Type In COMPUTE!'s GAZETTE Programs," which appears before the Program Listings.

Program 1: Apple Hunt—Redefined Characters (VIC Version)

```
10 POKE55,152:POKE56,28:CLR          :rem 67
```

```
20 FORI=1TO95:READA:X=X+A:NEXT:IFX<>12828
   THENPRINT"ERROR IN DATA STATEMENTS.":S
   TOP                                  :rem 69
30 RESTORE:FORI=828TO866:READA:POKEI,A:NE
   XT                                   :rem 70
40 DATA 173,5,144,41,3,10,10            :rem 73
50 DATA 105,16,133,254,169,128          :rem 197
60 DATA 133,252,169,0,133,251,133       :rem 78
70 DATA 253,168,162,2,177,251,145,253
                                        :rem 36
80 DATA 200,208,249,230,252,230,254
                                        :rem 179
90 DATA 202,208,242,96                  :rem 60
100 POKE36878,15:DIMN(16):FORI=1TO16:READ
   N(I):NEXT                            :rem 21
110 DATA135,163,175,195,207,209,215,225,2
   31,232,235,240,237,235,237,240
                                        :rem 217
120 POKE36879,25:PRINT"{CLR}"CHR$(142)CHR
   $(8)SPC(6)"{6 DOWN}{BLK}WELCOME TO"
                                        :rem 205
130 PRINTSPC(5)"{2 DOWN}{BLK}*{RED}A{CYN}
   P{PUR}P{GRN}L{BLU}E {YEL}H{BLK}U{RED}
   N{CYN}T{PUR}*":GOSUB600              :rem 241
140 PRINT"{BLU}{4 DOWN}{5 SPACES}{RVS}DO
   {SPACE}YOU NEED"SPC(10)"INSTRUCTIONS?
   "SPC(11)"{OFF}(Y OR N)"              :rem 95
150 GETY$:IFY$=""OR(Y$<>"Y"ANDY$<>"N")THE
   N150                                 :rem 97
160 Y=(Y$="Y"):PRINT"{CLR}":POKE36869,255
   :SYS828:GOSUB500:IFNOT Y THEN440
                                        :rem 184
170 PRINT"{CLR}":POKE36879,251          :rem 58
180 PRINTSPC(5)"{RVS}{PUR}YOU ARE:{OFF}
   {BLK}S":PRINTSPC(5)"{DOWN}{RVS}{PUR}M
   ONSTER:{OFF}{BLU}!":PRINTSPC(5)"
   {DOWN}{RVS}{PUR}APPLE:{OFF}{RED}V"
                                        :rem 88
190 PRINTSPC(5)"{DOWN}{RVS}{PUR}TREE:
   {GRN}{OFF}U":PRINTSPC(5)"{DOWN}{RVS}
   {PUR}RUBY:Z"                         :rem 145
200 PRINT"{2 DOWN}{RVS}{BLK}SCORING:":PRI
   NT"{DOWN}{RED}V{RVS}:50-500 POINTS":P
   RINT"{DOWN}{BLU}!{RVS}:1000 POINTS"
                                        :rem 154
210 PRINT"{DOWN}{PUR}{RVS}Z:3000 POINTS"
                                        :rem 215
220 GOSUB640                            :rem 174
230 PRINT"{CLR}{DOWN}{BLK}S {RVS}{BLU}MUS
   T GRAB 5 {RED}{OFF}V{RVS}{BLU}
   {7 SPACES}BEFORE THE TIME IS UP"
                                        :rem 241
240 PRINT"{BLK}{RVS}THE {BLU}{OFF}!{BLK}
   {RVS} EATS THE {RED}{OFF}V{RVS}{BLK}
   {SPACE}AND{2 SPACES}THE{GRN}{OFF} U
   {BLK}"                               :rem 91
250 PRINT"{DOWN}{RVS}{BLK}EVERY WAVE THER
   E ARE{2 SPACES}MORE {OFF}{GRN}U{BLK}
                                        :rem 207
260 PRINT"{DOWN}{RVS}{BLU}USE THE JOYSTIC
   K TO{3 SPACES}MOVE {OFF}{BLK}S{RVS}
   {BLU} IN 4 DIRECTIONS"               :rem 40
270 GOSUB640                            :rem 179
280 PRINT"{CLR}{2 DOWN}{3 RIGHT}{BLK}S
   {RVS} {BLU}WILL LOSE IF HE"          :rem 18
290 PRINTSPC(4)"{DOWN}{RVS}HITS A {GRN}
   {OFF}U{RVS}{BLU} OR IS"              :rem 230
300 PRINTSPC(2)"{DOWN}{RVS}{BLU}TOUCHED B
   Y THE{OFF} !{BLK}"                   :rem 218
310 PRINT"{2 DOWN}{RVS}{RED}YOUR GAME IS
   {SPACE}OVER IF {BLK}{OFF}S{RVS}":PRIN
   TSPC(4)"{RVS}{RED}TAKES TOO LONG"
                                        :rem 74
320 GOSUB640                            :rem 175
330 PRINT"{CLR}{2 DOWN}{BLU}{RVS}EXTRA
   {OFF}{BLK}S{RVS}{BLU} & ZAP AFTER
   {3 SPACES}WAVES 5,10,15,20 & 25"
                                        :rem 239
340 PRINT"{2 DOWN}{BLU}{RVS}WHEN {OFF}
   {BLK}S{RVS}{BLU} IS RUNNING OUT OF TI
   ME, THE SCREEN{3 SPACES}WILL TURN
   {RED}RED"                            :rem 81
350 PRINT"{2 DOWN}{BLU}{RVS}THE FASTER
   {OFF}{BLK}S{RVS}{BLU} FINISHES A WAVE
     THE MORE BONUSPOINTS ARE AWARDED
                                        :rem 39
360 GOSUB640                            :rem 179
370 PRINT"{CLR}{2 DOWN}{RVS}{BLU}PRESSING
    THE JOYSTICK BUTTON RELEASES A ZAP"
                                        :rem 105
380 PRINT"{DOWN}{BLK}S {RVS}MAY ONLY FIRE
    A ZAP WHEN STATIONARY"              :rem 45
390 PRINT"{DOWN}{RVS}{RED}A ZAP DESTROYS
   {SPACE}{OFF}{GRN}U{RED}{RVS}
   {6 SPACES}SURROUNDING IT IN 8
   {3 SPACES}DIRECTIONS AND RESETS TIME
                                        :rem 254
400 PRINT"{DOWN}{RVS}{BLK}USING A ZAP CHA
   SES THE";                            :rem 157
410 PRINT"{OFF}{BLU}!{BLK}{RVS} TO ANOTHE
   R PLACE IN THE FOREST OR MAKES
   {3 SPACES}THE {OFF}{BLU}! {BLK}{RVS}D
   ISAPPEAR"                            :rem 62
420 PRINT"{2 DOWN}{RIGHT}{RVS}HIT ANY KEY
    TO START"                           :rem 159
430 GETA$:IFA$=""THEN430                :rem 81
440 PRINT"{CLR}":POKE36879,25:POKE36869,2
   40                                   :rem 68
450 PRINT"{BLK}{3 DOWN}FOR TAPE, PRESS PL
   AY"                                  :rem 45
460 PRINT"{2 DOWN}JUST A FEW MOMENTS
   {4 SPACES}WHILE I LOAD THE{6 SPACES}S
   ECOND PART"                          :rem 207
470 S$="LO"+CHR$(34)+"P2"+CHR$(34)+",1:"+
   CHR$(131)                            :rem 127
480 REM CHANGE 1 TO 8 IN PRIOR LINE IF YO
   U ARE USING A DISK DRIVE             :rem 77
490 FORI=1TOLEN(S$):POKE630+I,ASC(MID$(S$
   ,I)):NEXT:POKE198,I:END              :rem 148
500 FORC=7320TO7327:READA:POKEC,A:NEXT
                                        :rem 103
510 DATA60,66,165,129,165,153,66,60
                                        :rem 245
520 FORC=7432TO7439:READA:POKEC,A:NEXT
                                        :rem 113
530 DATA195,34,20,156,126,29,8,119
                                        :rem 193
540 FORC=7328TO7335:READA:POKEC,A:NEXT
                                        :rem 114
550 DATA60,66,165,129,153,165,66,60
                                        :rem 249
560 FORC=7336TO7343:READA:POKEC,A:NEXT
                                        :rem 114
570 DATA0,28,62,127,127,62,8,8          :rem 248
580 FORC=7344TO7351:READA:POKEC,A:NEXT:RE
   TURN                                 :rem 140
590 DATA6,8,60,126,126,126,60,24        :rem 87
600 POKE36878,15:FORO=0TO8:FORL=1+OTO8+O:
   N=N(L)                               :rem 121
610 POKE36876,N:FORT=1TO50:NEXT:NEXT:NEXT
   :FORV=15TO0STEP-1:POKE36878,V:FORT=1T
   O300:NEXT                            :rem 184
```

```
620 POKE36878,0:POKE36876,0          :rem 6
630 RETURN                           :rem 121
640 PRINT"{2 DOWN}{BLK}{RVS}{5 RIGHT}HIT
    {SPACE}ANY KEY"                  :rem 118
650 GETA$:IFA$=""THEN650             :rem 89
660 RETURN                           :rem 124
```

Program 2: Apple Hunt—Main Game (VIC Version)

```
2 S1=36874:S2=S1+1:S3=S2+1:V=S3+2:TP=3687
  9                                  :rem 149
4 GOSUB110:B%=0:SO=0:TX=0:X=RND(0):rem 36
6 PRINT"{CLR}":POKE36869,255:SC=7680:Q=30
  720:ZZ=25:W=1:ME=2:POKEV,15:ZA=2:POKE37
  154,127                            :rem 21
8 POKETP,251:NO=127:FORL=1TOZZ:X=INT(RND(
  1)*506)                            :rem 229
10 NO=NO+1:POKES2,NO:IFNO=>254THENNO=127
                                     :rem 10
12 POKESC+Q+X,5:POKESC+X,21:POKES2,0:NEXT
   :ZZ=ZZ+15:TR=INT(RND(1)*4)+6      :rem 74
14 FORP=1TOTR:POKES3,240:TA=INT(RND(1)*50
   6)+SC:POKETA,22:POKETA+Q,2        :rem 158
16 IFINT(RND(1)*100)+1<=3THENPOKETA,218:P
   OKETA+Q,4                         :rem 239
18 POKES3,0:NEXT:SX=INT(RND(1)*506)+SC:PO
   KESX,33:POKESX+Q,6                :rem 213
20 PO=INT(RND(1)*506)+SC:IFPO=SXTHEN20
                                     :rem 71
22 POKEPO,19:POKEPO+Q,0:FORL=1TO3:POKEPO,
   19:FORP=1TO100:POKES2,200:NEXT    :rem 47
24 POKEPO,32:FORP=1TO100:POKES2,0:NEXT:NE
   XT:POKEPO,19                      :rem 178
26 TI$="000000"                      :rem 202
28 IFTI=>786THENPOKETP,154:IFTI=>966THEN6
   2                                 :rem 155
30 POKES3,0:J=(PEEK(37137)AND28)OR(PEEK(3
   7152)AND128)                      :rem 22
32 ONABS((J-100)/4)-7GOTO50,50,34,,36,38,
   124,,,,40,50,50                   :rem 92
34 DR=-1:NO=165:GOTO42               :rem 33
36 DR=22:NO=189:GOTO42               :rem 47
38 DR=-22:NO=210:GOTO42              :rem 79
40 DR=1:NO=225                       :rem 21
42 POKES2,NO:PO=PO+DR:IFPO>8187THENPO=PO-
   506:POKEPO-DR+506,32              :rem 107
44 IFPO<7680THENPO=PO+506:POKEPO-DR-506,3
   2                                 :rem 59
46 IFPEEK(PO)<>32THEN64              :rem 134
48 POKEPO-DR,32:POKEPO,19:POKEPO+Q,0:POKE
   S2,0                              :rem 86
50 POKES1,128:POKESX,32:X=INT(RND(1)*8)+1
                                     :rem 179
52 JJ=(X=2)*22-(X=1)*22-(X=3)+(X=4)+(X=5)
   *23-(X=6)*23+(X=7)*21-(X=8)*21:rem 149
54 SX=SX+JJ:IFSX<7680THENSX=SX+506:POKESX
   -JJ,32                            :rem 46
56 IFSX>8187THENSX=SX-506:POKESX-JJ,32
                                     :rem 171
58 IFPEEK(SX)=19THENPOKESX-JJ,33:POKESX+Q
   -JJ,6:POKEPO,20:POKEPO+Q,0:GOTO78
                                     :rem 43
60 POKESX,33:POKESX+Q,6:POKES1,0:GOTO28
                                     :rem 234
62 PRINT"{2 DOWN}{RVS}{BLK}TOOK TOO LONG"
   :POKEPO,20:POKEPO+Q,0:GOTO82      :rem 175
64 IFPEEK(PO)=21ORPEEK(PO)=33THENPOKEPO-D
   R,20:POKEPO+Q-DR,0:GOTO78         :rem 218
66 IFPEEK(PO)<>22THEN72              :rem 134
68 POKEPO-DR,32:POKEPO,19:POKEPO+Q,0:SO=S
   O+INT(RND(1)*10+1)*50:POKES3,230+B%:TX
   =TX+1                             :rem 121
70 IFTX>4THEN94                      :rem 176
72 IF PEEK(PO)<>218THENB%=B%+2:GOTO48
                                     :rem 152
74 POKEPO-DR,32:POKEPO,19:POKEPO+Q,0
                                     :rem 11
76 PRINT"{HOME}{RVS}{2 RIGHT}{BLK}3000 PO
   INTS!":SO=SO+3000:A1%=1:POKES3,250:GOT
   O94                               :rem 104
78 POKES1,0:POKES3,0:FORP=0TO53:POKES2,18
   0-P:FORL=1TO20:NEXT:NEXT          :rem 180
80 ME=ME-1:IFME=>1THENZZ=ZZ-15:PRINT"
   {CLR}":GOTO8                      :rem 222
82 PRINT"{HOME}{RVS}{4 DOWN}{BLK}":FORP=1
   TO10:PRINT"{RVS}{BLK}GAME OVER":POKES1
   ,128:FORL=1TO100:NEXT             :rem 86
84 PRINT"{UP}           {UP}":POKES1,0:FOR
   L=1TO100:NEXT:NEXT:IFSO>HSTHENHS=SO
                                     :rem 150
86 POKE36869,240:POKE198,0:PRINT"{CLR}
   {BLK}{2 DOWN}SCORE="SO:PRINT"{DOWN}WAV
   E"W:PRINT"{DOWN}{BLK}AGAIN(Y OR N)"
                                     :rem 204
88 GETC$:IFC$="N"THENPOKE37139,128:POKE37
   154,255:END                       :rem 40
90 IFC$="Y"THEN4                     :rem 156
92 GOTO88                            :rem 20
94 BO=INT(966-TI)*3:IFPEEK(TP)=154THENBO=
   0                                 :rem 42
96 PRINT"{HOME}{3 DOWN}{RVS}{BLK}WAVE";W;
   "OVER":TX=0:IFW=5ORW=10ORW=15ORW=20ORW
   =25THEN118                        :rem 186
98 W=W+1:PRINT"{RVS}{DOWN}BONUS="BO:SO=SO
   +BO:PRINT"{RVS}{DOWN}SCORE="SO    :rem 59
100 PRINT"{RVS}{DOWN}MEN=";ME:POKES1,0:PO
    KES2,0:POKES3,0:POKES3+1,0:PRINT"
    {RVS}{DOWN}ZAPS="ZA:B%=0         :rem 70
102 READN,D:IFN=-1THENPOKES2+A1%,0:A1%=0:
    GOTO108                          :rem 106
104 POKES2+A1%,N:FORP=1TOD:NEXT:GOTO102
                                     :rem 202
106 DATA200,180,0,5,210,180,0,5,220,200,0
    ,5,230,300,0,5,220,120,0,5,230,450,-1
    ,-1                              :rem 84
108 FORP=1TO2500:NEXT:PRINT"{CLR}":RESTOR
    E:GOTO8                          :rem 200
110 POKETP,30:PRINT"{CLR}{3 DOWN}{RED}"SP
    C(6)"APPLE HUNT{3 DOWN}":PRINT"
    {3 DOWN}{3 RIGHT}{BLK}HIGH SCORE="HS
                                     :rem 15
112 PRINT"{4 DOWN}{RIGHT}{PUR}{RVS}HIT AN
    Y KEY TO START"                  :rem 91
114 GETA$:IFA$=""THEN114             :rem 79
116 RETURN                           :rem 120
118 POKES2,0:FORP=1TO10:PRINT"{HOME}{RVS}
    EXTRA MAN & ZAP":POKES3,240:FORL=1TO1
    00:NEXT                          :rem 103
120 PRINT"{UP}                  ":POKES3,0:F
    ORL=1TO100:NEXT:NEXT:PRINT"{2 DOWN}"
                                     :rem 110
122 ME=ME+1:ZA=ZA+1:GOTO98           :rem 63
124 B=PEEK(37137)AND32:IFB<>0THEN50
                                     :rem 18
126 IFZA=<0THEN50                    :rem 0
128 ZA=ZA-1:POKETP,203               :rem 58
130 POKEPO+1,192:POKEPO-1,192:POKEPO-22,2
    21:POKEPO+22,221                 :rem 102
132 POKEPO+21,206:POKEPO-21,206:POKEPO-23
    ,205:POKEPO+23,205               :rem 202
134 POKEPO+1+Q,0:POKEPO-1+Q,1:POKEPO-22+Q
    ,2:POKEPO+22+Q,3                 :rem 190
```

```
136 POKEPO+21+Q,4:POKEPO-21+Q,5:POKEPO-23
    +Q,6:POKEPO+23+Q,7              :rem 54
138 FORL=1TO100:POKES3+1,150:NEXT:POKES3+
    1,0                            :rem 158
140 IFPEEK(SX)<>33THENSO=SO+1000:POKES3,2
    40:PRINT"{HOME}{RVS}{BLK}1000 POINTS!
    ":GOTO94                       :rem 209
142 POKESX,32:SX=SC+INT(RND(1)*506)+1:POK
    EPO+1,32:POKEPO-1,32:POKEPO-22,32:POK
    EPO+22,32                      :rem 230
144 POKEPO+21,32:POKEPO-21,32:POKEPO-23,3
    2:POKEPO+23,32:POKETP,251:TI$="000000
    ":GOTO50                       :rem 72
```

Program 3: Apple Hunt—64 Version

```
100 POKE56,48:CLR:TP=53280         :rem 251
110 FORI=1TO162:READA:X=X+A:NEXT   :rem 15
120 IFX<>90689THENPRINT"{CLR}{BLK}ERROR I
    N DATA STATEMENTS.":STOP       :rem 24
130 RESTORE:POKETP,12:POKETP+1,12:PRINT"
    {CLR}{WHT}{9 DOWN}"TAB(15)"WELCOME TO
    "                              :rem 9
140 PRINTTAB(14)"{4 DOWN}{BLK}*{RED}APPLE
     {BLU}HUNT{BLK}*":GOSUB1300:GOSUB370
                                   :rem 105
150 PRINT"{BLK}{4 DOWN}"TAB(6)"{RVS}NEED
    {SPACE}INSTRUCTIONS (Y OR N) ?"
                                   :rem 152
160 GETZ$:IFZ$=""OR(Z$<>"Y"ANDZ$<>"N")THE
    N160                           :rem 103
170 IFZ$="N"THEN440                :rem 59
180 POKETP,1:POKETP+1,1            :rem 143
190 A$="{CLR}{BLK}{4 DOWN}":PRINTA$"
    {2 SPACES}YOU ARE %. THE OBJECT OF TH
    E GAME IS{DOWN}"               :rem 84
200 PRINT"TO EAT ALL THE APPLES({RED}&
    {BLK})"                        :rem 130
210 PRINTTAB(25)"{UP}IN THE FOREST.
    {DOWN}YOU(%) MUST AVOID THE TREES(
    {GRN}[{BLK}) AND THE"          :rem 175
220 PRINT"{DOWN}MONSTER({BLU}!{BLK}). USE
     YOUR JOYSTICK TO MOVE % {DOWN}THROUG
    H THE FOREST."                 :rem 172
230 PRINTTAB(20)"{UP}% HAS LIMITED TIME
    {2 SPACES}{DOWN}TO EAT ALL {RED}&
    {BLK}. THE SCREEN WILL TURN";:rem 125
240 PRINT" RED":PRINT"{DOWN}IF % IS ABOUT
     TO RUN OUT OF TIME.":GOSUB1310
                                   :rem 42
250 PRINTA$"{WHT}{3 SPACES}{BLU}!{BLK} WI
    LL EAT {GRN}[{BLK} AS WELL AS {RED}&
    {BLK}. ";                      :rem 84
260 PRINT"IF % HITS {DOWN}{BLU}!{BLK} OR
    {SPACE}{GRN}[{BLK} YOU WILL LOSE."
                                   :rem 118
270 PRINTTAB(21)"{UP} PRESS THE FIRE
    {4 SPACES}{DOWN}BUTTON TO RELEASE A Z
    AP. A ZAP DESTROYS"            :rem 174
280 PRINT"{DOWN}{GRN}[{BLK} AND RESETS TI
    ME. IF {BLU}!{BLK} IS HIT BY A ZAP "
                                   :rem 50
290 PRINT"YOU WILL BE AWARDED 1000":PRINT
    TAB(25)"{UP}POINTS. ";         :rem 82
300 PRINT"{BLU}!{BLK} WILL {DOWN}HOVER AR
    OUND {RED}&{BLK} UNTIL % EATS IT OR
    {BLU}!{BLK} GETS{DOWN}IT.":GOSUB1310
                                   :rem 22
310 PRINTA$"{3 SPACES}SOMETIMES A RUBY (
    {PUR}#{BLK}) APPEARS ON THE{2 SPACES}
    {DOWN}SCREEN, YOU MUST TRY ";:rem 170
320 PRINT"TO GET {PUR}#{BLK} BEFORE {BLU}
    !{BLK}":PRINT"{DOWN}GETS IT. YOU CAN
    {SPACE}GAIN 3000 POINTS FOR"   :rem 74
330 PRINT"{DOWN}GETTING {PUR}#{BLK}. FOR
    {SPACE}EACH {RED}&{BLK} YOU CAN SCORE
    "                              :rem 28
340 PRINT"{DOWN}BETWEEN 50 TO 500 POINTS.
    "                              :rem 43
350 PRINTTAB(26)"{UP}AN EXTRA % AND{DOWN}
    ZAP ARE AWARDED AFTER WAVES 5,10,15,2
    0{DOWN}"                       :rem 76
360 PRINT"AND 25.":GOSUB1310:PRINT"{CLR}"
    :GOTO440                       :rem 250
370 POKE53272,28:SYS828            :rem 61
380 READV:IFV=-1THEN400            :rem 138
390 FORI=VTOV+7:READA:POKEI,A:NEXT:GOTO38
    0                              :rem 247
400 S=54272:FORL=STOS+24:POKEL,0:NEXT
                                   :rem 54
410 HF=S+1:DIMN(16):FORI=1TO16:READN(I):N
    EXT:GOSUB1340                  :rem 68
420 FORT=0TO8:READDR(T):NEXT       :rem 35
430 RETURN                         :rem 119
440 PRINT"{CLR}":SO=0:TX=0:SC=1024:ZZ=45:
    W=1:ME=2:ZA=2                  :rem 126
450 DEFFND(Z)=ABS((JV=2)*1+(JV=1)*2+(JV=8
    )*3+(JV=4)*4)                  :rem 201
460 POKETP,1:POKETP+1,1:FORL=1TOZZ:X=INT(
    RND(0)*960):POKESC+S+X,5:POKESC+X,27
                                   :rem 115
470 POKES+24,15:POKES+4,17:POKEHF,50:POKE
    S,100:POKES+4,16:NEXT:ZZ=ZZ+27
                                   :rem 138
480 TR=INT(RND(1)*6)+6:FORP=1TOTR:TA=INT(
    RND(1)*960)+SC                 :rem 66
490 POKES+4,65:POKEHF,15:POKES+3,15:POKES
    +2,20:POKES+4,64:POKETA,38:POKETA+S,2
                                   :rem 17
500 IFINT(RND(1)*100)+1<=3THENPOKETA,35:P
    OKETA+S,4                      :rem 236
510 POKES+4,17:POKEHF,50:POKES,200:POKES+
    4,16:NEXT                      :rem 52
520 SX=INT(RND(1)*960)+SC:POKESX,33:POKES
    X+S,6                          :rem 69
530 PO=INT(RND(1)*960)+SC:POKEPO,37:POKEP
    O+S,0                          :rem 32
540 FORL=1TO3:POKEPO,37:FORP=1TO100:NEXT
                                   :rem 58
550 POKEPO,32:FORP=1TO100:NEXT:NEXT:POKEP
    O,37                           :rem 156
560 TI$="000000"                   :rem 253
570 IFTI=>1100THENPOKETP,2:IFTI=>1400THEN
    710                            :rem 210
580 JV=PEEK(56320):FR=JVAND16:JV=15-(JVAN
    D15):IFFR=0THEN970             :rem 74
590 XX=FND(Z):IFXX=0THEN650        :rem 190
600 DR=DR(XX):PO=PO+DR:IFPO>2023THENPO=PO
    -960:POKEPO-DR+960,32          :rem 127
610 IFPO<1024THENPO=PO+960:POKEPO-DR-960,
    32                             :rem 100
620 IFPEEK(PO)<>32THEN720          :rem 227
630 POKES+4,65:POKEHF,15:POKEPO-DR,32:POK
    EPO,37:POKEPO+S,0:POKES+3,15   :rem 34
640 POKES+2,20:POKES+4,64          :rem 184
650 POKESX,32:X=INT(RND(1)*8)+1    :rem 53
660 JJ=DR(X)                       :rem 172
670 SX=SX+JJ:IFSX<1024THENSX=SX+960:POKES
    X-JJ,32                        :rem 88
680 IFSX>2023THENSX=SX-960:POKESX-JJ,32
                                   :rem 209
690 IFPEEK(SX)=37THENPOKESX-JJ,33:POKESX+
    S-JJ,6:POKEPO,29:POKEPO+S,0:GOTO790
                                   :rem 155
```

```
700 POKESX,33:POKESX+S,6:GOTO570    :rem 6
710 PRINT"{2 DOWN}{BLK}TOOK TOO LONG":POK
    EPO,29:POKEPO+S,0:GOTO800       :rem 6
720 IFPEEK(PO)=27ORPEEK(PO)=33THENPOKEPO-
    DR,29:POKEPO+S-DR,0:GOTO790     :rem 75
730 IFPEEK(PO)<>38THEN760           :rem 239
740 POKEPO-DR,32:POKEPO,37:POKEPO+S,0:SO=
    SO+INT(RND(1)*10+1)*50:TX=TX+1
                                    :rem 102
750 GOSUB1440:IFTX>4THEN890         :rem 156
760 IFPEEK(PO)<>35THEN630           :rem 235
770 POKEPO-DR,32:POKEPO,37:POKEPO+S,0
                                    :rem 64
780 PRINT"{HOME}{2 RIGHT}{BLK}3000 POINTS
    .":SO=SO+3000:GOTO890           :rem 216
790 GOSUB1390:ME=ME-1:IFME=>1THENZZ=ZZ-27
    :PRINT"{CLR}":GOTO460           :rem 2
800 PRINT"{HOME}{4 DOWN}{BLK}":FORP=1TO10
                                    :rem 51
810 PRINT"{BLK}GAME OVER":FORL=1TO100:NEX
    T                               :rem 216
820 PRINT"{UP}{13 SPACES}{UP}":FORL=1TO10
    0:NEXT:NEXT:IFSO>HSTHENHS=SO    :rem 123
830 POKETP,1:POKETP+1,1:PRINT"{CLR}"TAB(1
    2)"{BLK}{7 DOWN}SCORE="SO:PRINTTAB(12
    )"{DOWN}WAVE="W                 :rem 206
840 PRINTTAB(12)"{DOWN}HIGH SCORE="HS
                                    :rem 125
850 PRINTTAB(8)"{3 DOWN}{BLK}WISH TO PLAY
     AGAIN(Y/N)?":POKE198,0         :rem 210
860 GETZ$:IFZ$=""OR(Z$<>"Y"ANDZ$<>"N")THE
    N860                            :rem 117
870 IFZ$="Y"THENPRINT"{CLR}":GOTO440
                                    :rem 36
880 POKE53272,21:END                :rem 114
890 BO=INT(1400-TI)*3:IF(PEEK(TP)AND15)=2
    THENBO=0                        :rem 160
900 PRINT"{HOME}{3 DOWN}{BLK}WAVE";W;"OVE
    R":TX=0:TR=0:IFW=5ORW=10ORW=15ORW=20O
    RW=25THEN940                    :rem 34
910 W=W+1:PRINT"{DOWN}BONUS="BO:SO=SO+BO:
    PRINT"{DOWN}SCORE="SO           :rem 64
920 PRINT"{DOWN}MEN=";ME:PRINT"{DOWN}ZAPS
    =";ZA                           :rem 212
930 GOSUB1340:PRINT"{CLR}":GOTO460
                                    :rem 143
940 FORP=1TO10:PRINT"{HOME}EXTRA MAN AND
    {SPACE}ZAP":FORL=1TO100:NEXT    :rem 10
950 PRINT"{UP}{17 SPACES}":FORL=1TO100:NE
    XT:NEXT:PRINT"{2 DOWN}"         :rem 46
960 ME=ME+1:ZA=ZA+1:GOTO910         :rem 114
970 IFZA=<0THEN650                  :rem 61
980 ZA=ZA-1:POKETP+1,4:POKETP,3     :rem 167
990 POKEPO+1,64:POKEPO-1,64:POKEPO-40,93:
    POKEPO+40,93                    :rem 190
1000 POKEPO+39,78:POKEPO-39,78:POKEPO-41,
     77:POKEPO+41,77                :rem 99
1010 POKEPO+1+S,0:POKEPO-1+S,2:POKEPO-40+
     S,3:POKEPO+40+S,4              :rem 243
1020 POKEPO+39+S,5:POKEPO-39+S,6:POKEPO-4
     1+S,7:POKEPO+41+S,8            :rem 125
1030 FORL=1TO100:NEXT               :rem 18
1040 IFPEEK(SX)<>33THENSO=SO+1000:PRINT"
     {HOME}{BLK}1000 POINTS.":GOTO890
                                    :rem 127
1050 POKESX,32:SX=SC+INT(RND(1)*960)+1:PO
     KEPO+1,32:POKEPO-1,32          :rem 199
1060 POKEPO-40,32:POKEPO+40,32      :rem 223
1070 POKEPO+39,32:POKEPO-39,32:POKEPO-41,
     32:POKEPO+41,32                :rem 68
1080 POKETP,1:POKETP+1,1:TI$="000000":GOT
     O650                           :rem 105
1090 DATA 173,14,220,41,254,141,14
                                    :rem 123
1100 DATA 220,173,24,208,41,14,10   :rem 62
1110 DATA 10,133,167,169,208,133,252
                                    :rem 229
1120 DATA 173,0,221,41,3,73,3       :rem 123
1130 DATA 10,10,10,10,10,10,5       :rem 98
1140 DATA 167,133,254,165,1,41,251
                                    :rem 130
1150 DATA 133,1,169,0,133,251,133   :rem 71
1160 DATA 253,168,162,8,177,251,145
                                    :rem 197
1170 DATA 253,200,208,249,230,252,230
                                    :rem 19
1180 DATA 254,202,208,242,165,1,9   :rem 83
1190 DATA 4,133,1,173,14,220,9      :rem 182
1200 DATA 1,141,14,220,96           :rem 188
1210 DATA12584,60,66,165,129,165,153,66,6
     0                              :rem 83
1220 DATA12552,195,34,20,156,126,29,8,119
                                    :rem 25
1230 DATA12520,60,66,165,129,153,165,66,6
     0                              :rem 75
1240 DATA12504,0,28,62,127,127,62,8,8
                                    :rem 75
1250 DATA12592,6,8,60,126,126,126,60,24
                                    :rem 176
1260 DATA12568,60,126,255,255,126,60,24,8
     ,-1                            :rem 167
1270 DATA35,40,45,50,55,60,65,70,75,80,85
     ,90,95,100,105,110             :rem 133
1280 REM DATA35,63,75,95,107,109,115,125,
     131,132,135,140,137,135,137,140
                                    :rem 38
1290 DATA0,40,-40,1,-1,-41,41,-39,39
                                    :rem 246
1300 AD=828:FORI=ADTOAD+81:READA:POKEI,A:
     NEXTI:RETURN                   :rem 162
1310 PRINTTAB(14)"{2 DOWN}{RVS}HIT ANY KE
     Y{OFF}"                        :rem 159
1320 GETZ$:IFZ$=""THEN1320          :rem 225
1330 RETURN                         :rem 167
1340 POKES+24,15:POKES+5,90:POKES+6,240
                                    :rem 253
1350 POKES+4,17:FORO=0TO3           :rem 241
1360 FORL=1+OTO8+O:POKEHF,N(L)      :rem 72
1370 POKES,110:FORT=1TO50:NEXT:NEXT:NEXT:
     FORV=15TO0STEP-1:POKES+24,V    :rem 183
1380 FORI=1TO50:NEXT:NEXT:POKES+4,16:RETU
     RN                             :rem 44
1390 POKES+24,15:POKES+5,90:POKES+6,240
                                    :rem 2
1400 POKES+4,17                     :rem 58
1410 FORL=50TO5STEP-5:POKEHF,L      :rem 128
1420 POKES,5:FORT=1TO50:NEXT:NEXT:FORV=15
     TO0STEP-1:POKES+24,V           :rem 221
1430 FORI=1TO50:NEXT:NEXT:POKES+4,16:RETU
     RN                             :rem 40
1440 POKES+24,15:POKES+4,65:POKES+3,15:PO
     KES+2,20:FORI=1TO250STEP5      :rem 246
1450 POKEHF,I:NEXT:POKES+4,64:RETURN
                                    :rem 64
```

BEFORE TYPING . . .

Before typing in programs, please refer to "How To Type In COMPUTE!'s GAZETTE Programs," which appears before the Program Listings.

Number Quest

(Article on page 67.)

Program 1: Number Quest—64 Version

```
10 PRINT"{CLR}{10 RIGHT}{12 DOWN}";"JUST
   {SPACE}A MOMENT..."                  :rem 19
20 POKE56,48:CLR:K=12288:PC=56334:CP=5327
   2                                    :rem 146
30 IF PEEK(12288)+PEEK(12289)=162THEN60
                                        :rem 127
40 POKEPC,PEEK(PC)AND254:POKE1,PEEK(1)AND
   251                                  :rem 161
50 FORJ=0TO4095:POKEK+J,PEEK(53248+J):NEX
   TJ                                   :rem 129
60 FORI=216TO255:READA%:POKEK+I,A%:NEXTI:
   FORI=280TO295:READA%:POKEK+I,A%:NEXTI
                                        :rem 159
70 POKE1,PEEK(1)OR4:POKEPC,PEEK(PC)OR1
                                        :rem 114
80 POKECP,21:BC=53280:BK=53281:POKEBC,2:P
   OKEBK,1:PRINT"{CLR}"                 :rem 251
90 PRINTSPC(90)"{BLK}{2 SPACES}[M][M][2 G]
   [2 M][MN][G][O][G][O O][G]"          :rem 109
100 PRINT"{12 SPACES}[M] [G][L@[M]
    {2 SPACES}[G][O[G][O O[G]"          :rem 55
110 PRINTTAB(21)"[T] [T]"               :rem 52
120 PRINT:PRINT"{RED}{13 SPACES}OP [G][M]
     O O PO"                            :rem 111
130 PRINT"{13 SPACES}L@[F]L@ O P [M][G]"
                                        :rem 23
140 PRINTTAB(19)"[T] [T]"               :rem 62
150 PRINTSPC(131)"{BLU}PRESS THE F1 KEY"
                                        :rem 32
160 V=54272:FORSL=VTOV+24:POKESL,0:NEXT
                                        :rem 232
170 POKEV+5,88:POKEV+4,33:POKEV+24,143:PO
   KEV+6,195                            :rem 200
180 READLF,HF,DR:IFLF=-1THEN200         :rem 122
190 POKEV,LF:POKEV+1,HF:FORT=1TODR:NEXTT:
   GOTO180                              :rem 167
200 POKEV,0:POKEV+1,0:POKEV+24,0        :rem 150
210 GETA$:IFA$=""THEN210                :rem 73
220 IFA$=CHR$(133)THEN240               :rem 115
230 GOTO210                             :rem 97
240 PRINT"{CLR}":POKEBC,7:POKEBK,15
                                        :rem 211
250 PRINTSPC(211)"{BLK}YOU HAVE {RED}5
   {BLK}TURNS":PRINTSPC(51)"TO GUESS A N
   UMBER"                               :rem 61
260 PRINTSPC(51)"{BLK}FROM {RED}10 {BLK}T
   O {RED}100":PRINTSPC(211)"{BLU}PRESS
   {SPACE}THE F1 KEY"                   :rem 234
270 GETA$:IFA$=""THEN270                :rem 85
280 IFA$=CHR$(133)THEN300               :rem 118
290 GOTO270                             :rem 109
300 PRINT"{CLR}":POKEBC,6:POKEBK,1:TN=1:P
   OKECP,(PEEK(CP)AND240)+12            :rem 93
310 PRINTSPC(92)"{BLU}GUESS THE NUMBER"
                                        :rem 87
320 PRINT:PRINTTAB(24)"{BLK}[£":PRINT"
   {12 DOWN}":PRINTTAB(19)"{BLK}]"
                                        :rem 99
330 PRINT"{BLK}]]]]]]]]]]]]]]]]]]]]]]]]]
   {BLU}↑↑↑↑↑{BLK}]]]]]]]]]]]]]]]]]]]]]]]
   ]]]]]]]]";                           :rem 177
340 FOR T= 1TO2                         :rem 21
350 PRINT"{BLK}]]]]]]]]]]]]]]]]]]]]]]]]]]
   ]]]]]]]]]]]]]]]]]]]]]]]]]]]]]]]]]]]]]"
                                        :rem 186
360 NEXT                                :rem 216
370 FORN=0TO40:POKE1983+N,29:POKE56255+N,
   0:NEXTN                              :rem 157
380 PRINT"{15 UP}"                      :rem 235
390 R=INT(RND(1)*90+10)                 :rem 236
400 PRINT"{BLK}{5 SPACES}TURN: ";"{RED}";
   TN:PRINT                             :rem 183
410 PRINT"{5 SPACES}";                  :rem 161
420 S$="":INPUTS$:S=VAL(S$):IFS<1ORS>100T
   HENGOSUB690:PRINT"{DOWN}";:GOTO400
                                        :rem 60
430 FOR U= 1 TO LEN(S$):UT=ASC(MID$(S$,U,
   1))                                  :rem 119
440 IF UT<48ORUT>57THEN U=LEN(S$):GOSUB69
   0:NEXT:PRINT"{DOWN}";:GOTO400        :rem 4
450 NEXT                                :rem 216
460 IF S>2 THEN490                      :rem 184
470 PRINT"{BLK}{2 SPACES}THAT'S TOO EASY"
   :FOR T=0TO1000:NEXT:PRINT"{UP}
   {18 SPACES}{2 UP}{RED}"              :rem 100
480 GOTO410                             :rem 106
490 IFS=RTHEN780                        :rem 220
500 TN=TN+1:IFTN=6THEN530               :rem 23
510 IFS>RTHEN610                        :rem 206
520 IFS<RTHEN630                        :rem 207
530 POKEV+24,143:FORM=60TO30STEP-2:POKEV,
   INT(M/3):POKEV+1,M:FORT=1TO10:NEXTT
                                        :rem 66
540 NEXTM:POKEV+24,0                    :rem 209
550 P=14:GOSUB710:POKEX,36:POKECX,6:POKEX
   +40,30:POKECX+40,6                   :rem 110
560 FORM=125TO15STEP-5:POKEV+24,M:FORT=1T
   O20:NEXTT:NEXTM:POKEV+24,0           :rem 59
570 PRINT"{CLR}":POKESC,216:PRINTSPC(210)
   "{BLK}SORRY, YOU{2 SPACES}MISSED"
                                        :rem 182
580 PRINTSPC(130)"THE NUMBER WAS{RED} ";R
                                        :rem 119
590 PRINTSPC(49)"{BLK}BETTER LUCK NEXT TI
   ME":FORU=1TO 1200:NEXTU              :rem 30
600 GOTO850                             :rem 108
610 D=INT(S/R):D$="HIGH":IFD<=1THEN680
                                        :rem 239
620 GOTO640                             :rem 107
630 D=INT(R/S):D$="LOW":IFD<=1THEN680
                                        :rem 195
640 PRINT"{RED} ";D;"{BLK} TIMES TOO ";"
   {RED}";D$                            :rem 199
650 POKEV+24,143:FORM=50TO0STEP-1:POKEV,I
   NT(M/2):POKEV+1,M:NEXTM              :rem 33
660 FORT=1TO600:NEXT:POKEV+24,0         :rem 163
670 PRINT"{UP}{19 SPACES}":PRINT"{5 UP}":
   GOTO400                              :rem 230
680 PRINT"{RED}{4 SPACES}TOO ";"{BLU}";D$
   :FORT=1TO400:NEXT:GOTO650            :rem 95
690 PRINT"{RED}{5 SPACES}TRY 1-100
   {2 SPACES}":FORT=1TO800:NEXTT:rem 101
700 PRINT"{UP}{14 SPACES}":PRINT"{5 UP}";
   :RETURN                              :rem 46
710 X=1024+(5*40)+26:CX=X+54272:Z=1024+(5
   *40)+24:CZ=Z+54272                   :rem 100
720 FORN=1TOP:POKEZ,32:POKEZ+1,32:POKEX,3
   2:POKEX+40,32                        :rem 102
730 POKEZ-1,27:POKECZ-1,0:POKEZ,28:POKECZ
   ,0                                   :rem 145
740 POKEX+40,31:POKECX+40,2:POKEX+80,35:P
   OKECX+80,0                           :rem 13
750 Z=Z-1:CZ=CZ-1:X=X+40:CX=CX+40:NEXTN:R
   ETURN                                :rem 205
760 BL=53265:FORN=1TO6:POKEBL,PEEK(BL)AND
```

```
    239:FORT=1TO50:NEXTT          :rem 115
770 POKEBL,PEEK(BL)OR16:FORT=1TO40:NEXTT:
    NEXTN:RETURN                  :rem 43
780 GOSUB760:P=5:GOSUB710:FORN=1TO7
                                  :rem 193
790 POKEX,32:POKEX+40,32          :rem 153
800 POKEX+39,31:POKECX+39,2:POKEX+79,35:P
    OKECX+79,0:X=X+39:CX=CX+39:NEXTN
                                  :rem 243
810 POKEV+24,143:FORM=30TO60:POKEV,INT(M/
    2):POKEV+1,M:FORT=1TO10:NEXTT:NEXTM
                                  :rem 109
820 POKEV+24,0:POKEV,0:POKEV+1,0  :rem 158
830 PRINT"{CLR}":POKEBC,2:POKEBK,1:PRINT:
    PRINT:PRINTSPC(130)"{BLK}**CONGRATULA
    TIONS**"                      :rem 183
840 PRINTSPC(173)"{RED}YOU GUESSED IT"
                                   :rem 5
850 PRINTSPC(191);                :rem 55
860 FOR Q= 1TO 1000:NEXT:TN=1:GOTO300
                                  :rem 113
870 DATA255,1,1,1,127,255,255,127,255,0,0
    ,3,3,255,255,0                :rem 178
880 DATA255,255,255,255,255,255,255,255,1
    70,170,255,255,255,255,255,255 :rem 6
890 DATA60,126,255,255,129,66,36,24,16,18
    ,60                           :rem 183
900 DATA88,40,36,66,0,17,130,68,37,6,148,
    93,126                        :rem 72
910 DATA31,21,200,30,25,450,31,21,200,96,
    22,200,30,25,200,96,22,200,31,21,200
                                  :rem 184
920 DATA30,25,500,-1,-1,-1        :rem 10
```

Program 2: Number Quest—VIC Version

```
10 PRINT"{CLR}{11 DOWN}{5 RIGHT}PLEASE WA
   IT"                             :rem 0
20 POKE55,0:POKE56,28:CLR         :rem 220
30 B=7168:CB=25600:FORJ=0TO511:POKEB+J,PE
   EK(B+J+CB):NEXTJ               :rem 175
40 FORI=216TO255:READA%:POKEB+I,A%:NEXTI:
   FORI=280TO295:READA%:POKEB+I,A%:NEXTI:
   PRINT"{CLR}"                   :rem 41
50 POKE36869,240:SC=36879:POKESC,233
                                  :rem 71
60 PRINTSPC(89)"{BLK}{2 SPACES}{M}M{2 G}
   {2 M}MN{G}O{G}O O{G}"          :rem 114
70 PRINT"{3 SPACES}{M} {G}L@{M}{2 SPACES}
   {G}O{G}O O{G}"                 :rem 13
80 PRINTTAB(12)"{T} {T}"          :rem 10
90 PRINT"{RED}{5 SPACES}OP {G}{M} O O PO"
                                  :rem 126
100 PRINT"{5 SPACES}L@{F}L@ O P {M}{G}"
                                  :rem 20
110 PRINTTAB(11)"{T} {T}"         :rem 51
120 V=36878:F2=36875:POKEV,15     :rem 131
130 READA%,D%:IFA%=-1THEN150      :rem 58
140 POKEF2,A%:FORT=1TOD%:NEXTT:GOTO130
                                  :rem 145
150 POKEV,0:POKEF2,0              :rem 180
160 FORT=1TO1000:NEXTT            :rem 113
170 PRINT"{CLR}":POKESC,26:PRINTSPC(157)"
    {BLK}YOU HAVE {RED}5 {BLK}TURNS"
                                  :rem 156
180 PRINT:PRINT"{2 SPACES}TO GUESS
    {2 SPACES}A NUMBER"           :rem 101
190 PRINT:PRINT"{BLK}{4 SPACES}FROM {RED}
    10 {BLK}TO {RED}100":FORT=1TO4000:NEX
    TT                            :rem 106
200 PRINT"{CLR}":POKESC,27:TN=1:POKE36869
    ,255                          :rem 21
210 PRINTSPC(46)"{BLU}GUESS THE NUMBER"
                                  :rem 85
220 PRINT:PRINT:PRINTTAB(14)"{BLK}[£":PR
    INT"{12 DOWN}":PRINTTAB(10)"{BLK}]"
                                  :rem 31
230 PRINT"{BLK}]]]]]]]]]]]]]]]]{BLU}↑↑
    {BLK}]]]]";:PRINT"]]";        :rem 224
240 PRINT"]]]]]]]]]]]]]]]]]]":POKE8163,2
    9:POKE38883,0                 :rem 243
250 FORN=0TO21:POKE8164+N,29:POKE38884+N,
    0:NEXTN                       :rem 159
260 PRINT"{16 UP}"                :rem 121
270 R=INT(RND(1)*90+10)           :rem 233
280 PRINT"{BLK}{2 SPACES}TURN: ";"{RED}";
    TN:PRINT                      :rem 189
290 S$="":INPUT"{RED}{3 SPACES}";S$
                                  :rem 111
300 S=VAL(S$):IFS<1ORS>100THENGOSUB570
                                  :rem 101
310 FORU=1TOLEN(S$):UQ=ASC(MID$(S$,U,1))
                                  :rem 113
320 IF UQ<48OR UQ>57THENU=LEN(S$):NEXT:GO
    SUB570:GOTO280                :rem 167
330 NEXT                          :rem 213
340 IF S>2THEN370                 :rem 178
350 PRINT"THAT'S TOO EASY";:FOR T= 0TO100
    0:NEXT                        :rem 50
360 PRINT"{15 LEFT}{15 SPACES}{2 UP}":GOT
    O290                          :rem 205
370 IFS=RTHEN650                  :rem 213
380 TN=TN+1:IFTN=6THEN410          :rem 26
390 IFS>RTHEN490                  :rem 218
400 IFS<RTHEN510                  :rem 201
410 POKEV,15:FORM=220TO190STEP-1:POKEF2,M
    :FORT=1TO20:NEXTT:NEXTM:POKEF2,0:POKE
    V,0                           :rem 239
420 P=14:GOSUB580:POKEX,36:POKECX,6:POKEX
    +22,30:POKECX+22,6            :rem 111
430 POKE36877,220:FORL=15TO5STEP-1:POKEV,
    L:FORM=1TO50                   :rem 50
440 NEXTM:NEXTL:POKE36877,0:POKEV,0
                                  :rem 216
450 PRINT"{CLR}":POKESC,216:PRINTSPC(157)
    "{BLK}SORRY,YOU MISSED"       :rem 189
460 PRINTSPC(46)"THE NUMBER WAS {RED}";R
                                   :rem 74
470 PRINTSPC(49)"{BLK}BETTER LUCK
    {12 SPACES}NEXT TIME":FORT=1TO1000:NE
    XTT                           :rem 23
480 GOTO700                       :rem 108
490 D=INT(S/R):D$="HIGH":IFD<=1THEN560
                                  :rem 242
500 GOTO520                       :rem 101
510 D=INT(R/S):D$="LOW":IFD<=1THEN560
                                  :rem 189
520 PRINT"{RED} ";D;"{BLK} TIMES TOO ";"
    {RED}";D$                     :rem 196
530 POKEV,15:FORM=250TO180STEP-1:POKEF2,M
    :NEXTM:FORT=1TO1000:NEXT:POKEV,0
                                  :rem 194
540 PRINT"{2 UP}{10 SPACES}"      :rem 140
550 PRINT"{21 SPACES}":PRINT"{5 UP}":GOTO
    280                           :rem 88
560 PRINT"{RED} TOO ";"{BLU}";D$:FORT=1TO
    400:NEXT:GOTO530              :rem 89
570 PRINT"{RED} TRY 1-100{2 SPACES}":FORT
    =1TO800:NEXTT:PRINT"{UP}{11 SPACES}":
    PRINT"{5 UP}":GOTO280         :rem 235
580 X=7680+(5*22)+17:CX=X+30720:Z=7680+(5
    *22)+15:CZ=Z+30720            :rem 117
```

```
590 FORN=1TOP:POKEZ,32:POKEZ+1,32:POKEX,3
    2:POKEX+22,32                    :rem 107
600 POKEZ-1,27:POKECZ-1,0:POKEZ,28:POKECZ
    ,0                               :rem 141
610 POKEX+22,31:POKECX+22,0:POKEX+44,35:P
    OKECX+44,0                       :rem 7
620 Z=Z-1:CZ=CZ-1:X=X+22:CX=CX+22:NEXTN:R
    ETURN                            :rem 201
630 BL=36865:FORN=1TO6:POKEBL,135:FORT=1T
    O50:NEXTT                        :rem 154
640 POKEBL,25:FORT=1TO40:NEXTT:NEXTN:RETU
    RN                               :rem 130
650 GOSUB630:P=5:GOSUB580:FORN=1TO7
                                     :rem 190
660 POKEX,32:POKEX+22,32             :rem 149
670 POKEX+21,31:POKECX+21,0:POKEX+43,35:P
    OKECX+43,0:X=X+21:CX=CX+21:NEXTN
                                     :rem 192
680 POKEV,15:FORL=130TO240:POKEF2,L:NEXTL
    :POKEV,0:FORT=1TO1000:NEXTT      :rem 121
690 PRINT"{CLR}":POKESC,26:PRINTSPC(157)"
    CONGRATULATIONS":PRINTSPC(69)"YOU
    {2 SPACES}GUESSED IT"            :rem 77
700 FORT=1TO2000:NEXTT:GOTO200       :rem 119
710 DATA255,1,1,1,127,255,255,127,255,0,0
    ,3,3,255,255,0                   :rem 171
720 DATA255,255,255,255,255,255,255,255,1
    70,170,255,255,255,255,255,255
                                     :rem 255
730 DATA60,126,255,255,129,66,36,24,16,18
    ,60,88,40,36,66,0,17,130,68,37,6,148,
    93,126                           :rem 113
740 DATA231,200,235,450,231,200,232,200,2
    35,200,232,200,231,200,235,500,-1,-1
                                     :rem 181
```

1526 Hi-Res Screen Dump

(Article on page 113.)

```
10 PRINT"{CLR}":PRINT TAB(12)"1526 HI-RES
    DUMP"                            :rem 7
20 PRINT:PRINT"PLEASE WAIT ...":PRINT
                                     :rem 58
30 READ LN,SA,EA:LN=LN+30            :rem 196
40 FOR I=0 TO EA-SA                  :rem 235
50 READ BY:POKE SA+I,BY:SUM=SUM+BY
                                     :rem 123
60 IF INT((I+1)/8)*8<>(I+1) THEN90
                                     :rem 248
70 READ CS:IF CS<>SUM THEN120        :rem 169
80 SUM=0:LN=LN+10                    :rem 1
90 NEXT                              :rem 168
100 IF INT(I/8)*8<>I THEN READ CS:IF CS<>
    SUM THEN120                      :rem 162
110 PRINT:PRINT"TYPE SYS49152 TO BEGIN HI
    -RES DUMP":END                   :rem 103
120 PRINT"**** ERROR IN LINE";LN     :rem 42
130 DATA 100                         :rem 63
140 DATA 49152                       :rem 180
150 DATA 49521                       :rem 181
160 DATA 169,18,133,10,32,33,192,32,619
                                     :rem 126
170 DATA 67,192,32,81,192,76,84,193,917
                                     :rem 156
180 DATA 32,177,192,162,8,230,3,208,1012
                                     :rem 170
190 DATA 2,230,4,202,208,247,76,65,1034
                                     :rem 122
200 DATA 193,173,0,221,41,3,73,3,707
                                     :rem 220
210 DATA 160,6,10,136,208,252,133,4,909
                                     :rem 117
220 DATA 173,24,208,41,8,240,7,24,725
                                     :rem 23
230 DATA 169,32,101,4,133,4,169,0,612
                                     :rem 14
240 DATA 133,3,96,24,165,3,105,64,593
                                     :rem 31
250 DATA 133,13,165,4,105,31,133,14,598
                                     :rem 120
260 DATA 96,169,0,32,189,255,169,4,914
                                     :rem 102
270 DATA 162,4,160,255,32,186,255,32,1086
                                     :rem 231
280 DATA 192,255,32,204,255,162,4,32,1136
                                     :rem 224
290 DATA 201,255,169,13,32,210,255,169,13
    04                               :rem 68
300 DATA 0,32,189,255,169,6,162,4,817
                                     :rem 35
310 DATA 160,6,32,186,255,32,192,255,1118
                                     :rem 227
320 DATA 32,204,255,162,6,32,201,255,1147
                                     :rem 214
330 DATA 169,18,32,210,255,169,0,32,885
                                     :rem 135
340 DATA 189,255,169,5,162,4,160,5,949
                                     :rem 99
350 DATA 32,186,255,32,192,255,32,204,118
    8                                :rem 28
360 DATA 255,162,4,32,201,255,169,254,133
    2                                :rem 20
370 DATA 32,210,255,169,141,32,210,255,13
    04                               :rem 58
380 DATA 96,32,204,255,162,5,32,201,987
                                     :rem 137
390 DATA 255,162,0,181,240,32,210,255,133
    5                                :rem 11
400 DATA 232,224,8,208,246,169,13,32,1132
                                     :rem 219
410 DATA 210,255,32,204,255,162,4,32,1154
                                     :rem 210
420 DATA 201,255,166,10,240,8,169,29,1078
                                     :rem 230
430 DATA 32,210,255,202,208,248,169,254,1
    578                              :rem 129
440 DATA 32,210,255,169,141,32,210,255,13
    04                               :rem 56
450 DATA 230,10,165,10,201,58,208,9,891
                                     :rem 123
460 DATA 169,18,133,10,169,13,32,210,754
                                     :rem 177
470 DATA 255,96,169,0,133,240,133,241,126
    7                                :rem 27
480 DATA 133,242,133,243,133,244,133,245,
    1506                             :rem 164
490 DATA 133,246,133,247,133,15,169,128,1
    204                              :rem 125
500 DATA 133,16,169,0,133,17,164,17,649
                                     :rem 130
510 DATA 177,3,37,16,240,16,169,128,786
                                     :rem 144
520 DATA 166,17,240,4,74,202,208,252,1163
                                     :rem 221
530 DATA 166,15,21,240,149,240,230,17,107
    8                                :rem 15
```

```
540 DATA 165,17,201,8,208,224,70,16,909
                                        :rem 132
550 DATA 230,15,165,15,201,8,208,210,1052
                                        :rem 209
560 DATA 96,165,3,197,13,208,10,165,857
                                        :rem 147
570 DATA 4,197,14,208,4,32,231,255,945
                                         :rem 87
580 DATA 0,76,13,192,169,0,133,17,600
                                         :rem 25
590 DATA 164,17,177,3,208,14,230,17,830
                                        :rem 132
600 DATA 165,17,201,8,208,242,32,232,1105
                                        :rem 212
610 DATA 192,76,19,192,32,250,192,76,1029
                                        :rem 241
620 DATA 16,192,208                     :rem 167
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MetaBASIC

(Article on page 114.)

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36864 :076,194,145,000,000,000,159
36870 :000,000,000,000,000,000,006
36876 :000,000,063,000,000,000,075
36882 :199,008,000,000,000,066,035
36888 :006,000,000,004,000,008,042
36894 :000,000,000,000,000,000,030
36900 :000,169,001,044,169,000,163
36906 :141,036,144,032,146,145,174
36912 :169,069,141,040,003,169,127
36918 :145,141,041,003,173,029,074
36924 :144,133,183,134,187,132,205
36930 :188,160,002,169,000,153,226
36936 :086,002,136,016,250,169,219
36942 :008,133,186,169,096,133,035
36948 :185,032,108,144,144,021,206
36954 :169,002,032,195,255,169,144
36960 :015,032,195,255,032,231,088
36966 :255,162,005,108,000,003,123
36972 :032,213,243,165,186,032,211
36978 :180,255,165,185,032,150,057
36984 :255,169,152,141,000,003,072
36990 :169,144,141,001,003,169,241
36996 :044,141,002,003,169,145,124
37002 :141,003,003,032,165,255,225
37008 :032,080,145,176,072,032,169
37014 :165,255,032,165,255,141,139
37020 :023,144,032,165,255,013,020
37026 :023,144,240,055,032,165,053
37032 :255,133,020,141,023,144,116
37038 :032,165,255,133,021,141,153
37044 :024,144,173,036,144,208,141
37050 :004,160,001,208,002,160,209
37056 :255,200,032,165,255,153,228
37062 :000,002,208,247,032,060,235
37068 :145,032,137,145,152,024,071
37074 :105,005,168,173,036,144,073
37080 :240,045,076,162,164,032,167
37086 :171,255,032,066,246,032,000
37092 :231,255,169,131,141,002,133
37098 :003,169,164,141,003,003,205
37104 :169,139,141,000,003,169,093
37110 :227,141,001,003,169,237,000
37116 :141,040,003,169,246,141,224
37122 :041,003,076,055,158,032,111
37128 :033,159,174,023,144,173,202
37134 :024,144,032,205,189,169,009
37140 :000,133,095,169,002,133,040
37146 :096,169,000,133,073,169,154
37152 :086,141,000,002,169,002,176
37158 :141,001,002,076,237,166,149
37164 :173,023,144,133,020,173,198
37170 :024,144,133,021,032,019,167
37176 :166,076,201,166,072,165,134
37182 :203,201,063,240,154,104,003
37188 :096,072,165,203,201,063,100
37194 :240,145,104,076,237,246,098
37200 :141,018,144,024,165,144,204
37206 :240,045,032,033,159,169,252
37212 :015,162,008,168,032,186,151
37218 :255,169,000,032,189,255,230
37224 :032,192,255,162,015,032,024
37230 :198,255,032,207,255,072,105
37236 :032,210,255,104,201,013,163
37242 :208,244,169,015,032,195,217
37248 :255,032,204,255,056,173,079
37254 :018,144,096,160,255,200,239
37260 :185,000,002,208,250,096,113
37266 :032,121,000,201,000,240,228
37272 :039,032,115,000,144,008,234
37278 :201,034,240,004,056,076,001
37284 :181,145,032,158,173,165,250
37290 :013,208,009,032,155,188,007
37296 :165,100,164,101,024,096,058
37302 :032,130,183,141,029,144,073
37308 :166,034,164,035,056,096,227
37314 :120,169,235,141,004,003,098
37320 :169,145,141,005,003,169,064
37326 :065,141,020,003,169,147,239
37332 :141,021,003,032,062,148,107
37338 :088,165,056,201,144,144,248
37344 :007,169,144,133,056,032,253
37350 :092,166,076,055,158,162,171
37356 :255,232,189,000,002,201,091
37362 :032,240,248,160,255,141,038
37368 :023,144,200,192,224,176,183
37374 :079,217,081,146,208,024,241
37380 :140,024,144,142,025,144,111
37386 :232,200,185,081,146,048,134
37392 :029,221,000,002,240,244,240
37398 :172,024,144,174,025,144,193
37404 :200,192,224,176,045,185,026
37410 :081,146,016,246,173,023,207
37416 :144,200,200,076,250,145,031
37422 :142,027,144,134,122,232,079
37428 :189,000,002,240,004,201,176
37434 :065,176,017,200,185,081,014
37440 :146,141,076,146,200,185,190
37446 :081,146,141,077,146,076,225
37452 :039,159,076,124,165,065,192
37458 :085,084,207,021,152,066,185
37464 :083,065,086,197,039,159,205
37470 :067,065,212,047,147,067,187
37476 :072,065,078,071,197,212,027
37482 :155,068,069,070,065,085,106
37488 :076,212,242,147,068,069,158
37494 :076,069,084,197,182,148,106
37500 :068,076,073,083,212,040,164
37506 :144,068,085,077,208,087,031
37512 :151,069,082,210,056,148,084
37518 :070,073,078,196,200,155,146
37524 :072,069,076,208,238,157,200
37530 :073,078,212,194,145,075,163
37536 :069,217,149,147,076,076,126
37542 :073,083,212,144,157,077,144
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37548 :069,077,079,082,217,057,241
37554 :149,077,069,082,071,197,055
37560 :037,144,077,079,078,073,160
37566 :084,079,210,004,150,078,027
37572 :085,077,066,069,210,166,101
37578 :150,081,085,073,212,001,036
37584 :150,082,069,065,196,103,105
37590 :148,082,069,078,085,205,113
37596 :000,153,082,069,083,065,160
37602 :086,197,014,150,083,067,055
37608 :082,065,084,067,200,005,223
37614 :150,083,069,078,196,025,071
37620 :150,083,080,069,069,196,123
37626 :229,157,083,084,065,082,182
37632 :212,106,148,084,069,082,189
37638 :077,073,078,065,204,064,055
37644 :158,084,082,065,067,197,153
37650 :174,152,084,082,079,070,147
37656 :198,243,152,085,078,078,090
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37668 :072,065,078,071,197,188,195
37674 :155,064,160,208,147,160,168
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37686 :200,192,004,208,246,076,212
37692 :040,144,034,036,000,165,223
37698 :203,205,014,144,240,074,178
37704 :141,014,144,201,003,208,015
37710 :004,169,007,208,008,201,163
37716 :004,144,059,201,007,176,163
37722 :055,056,233,004,010,010,202
37728 :010,010,010,174,141,002,187
37734 :240,003,024,105,016,168,146
37740 :162,000,185,097,159,201,144
37746 :095,208,002,169,013,201,034
37752 :039,208,008,165,212,073,057
37758 :001,133,212,169,034,201,108
37764 :000,240,009,157,119,002,147
37770 :232,200,224,010,208,222,210
37776 :134,198,076,049,234,032,099
37782 :146,145,136,152,048,047,056
37788 :201,008,176,043,010,010,092
37794 :010,010,024,105,097,133,029
37800 :251,169,159,105,000,133,217
37806 :252,032,146,145,144,023,148
37812 :173,029,144,201,011,176,146
37818 :016,168,169,000,145,251,167
37824 :136,177,034,145,251,136,047
37830 :016,249,076,055,158,162,146
37836 :011,108,000,003,169,255,238
37842 :133,251,032,166,145,176,089
37848 :242,140,234,147,141,235,075
37854 :147,032,146,145,176,011,111
37860 :152,230,251,164,251,153,149
37866 :000,000,076,223,147,108,020
37872 :002,003,120,169,095,141,002
37878 :024,003,169,157,141,025,253
37884 :003,088,169,003,133,251,131
37890 :032,146,145,176,010,152,151
37896 :166,251,157,019,144,198,175
37902 :251,016,241,169,040,141,104
37908 :050,003,169,148,141,051,070
37914 :003,169,048,141,048,003,182
37920 :169,148,141,049,003,076,106
37926 :055,158,174,019,144,134,210
37932 :186,076,237,245,174,019,213
37938 :144,134,186,076,165,244,231
37944 :032,088,145,076,055,158,098
37950 :169,073,141,038,003,169,143
37956 :148,141,039,003,096,072,055
37962 :138,072,152,072,173,141,054
37968 :002,208,251,174,012,144,103
37974 :232,160,001,136,208,253,052
37980 :202,208,250,104,168,104,104
37986 :170,104,076,202,241,169,036
37992 :001,044,169,000,141,011,214
37998 :144,032,146,145,032,189,030
38004 :255,169,002,162,008,160,104
38010 :002,032,186,255,032,192,053
38016 :255,144,003,076,090,144,072
38022 :162,002,032,198,255,032,047
38028 :165,255,032,080,145,176,225
38034 :024,174,011,144,208,010,205
38040 :170,032,165,255,032,205,243
38046 :189,076,171,148,032,210,216
38052 :255,032,060,145,076,139,103
38058 :148,169,002,032,195,255,203
38064 :032,204,255,076,055,158,188
38070 :032,146,145,176,115,132,160
38076 :253,133,254,032,049,149,034
38082 :160,002,177,095,141,023,024
38088 :144,200,177,095,141,024,213
38094 :144,165,095,133,251,165,135
38100 :096,133,252,032,146,145,248
38106 :176,082,200,208,003,024,143
38112 :105,001,032,049,149,056,104
38118 :165,101,229,253,165,100,219
38124 :229,254,144,062,160,000,061
38130 :140,000,002,165,095,145,021
38136 :251,200,165,096,145,251,076
38142 :173,023,144,133,020,173,152
38148 :024,144,133,021,160,005,235
38154 :173,002,003,133,251,173,233
38160 :003,003,133,252,169,033,097
38166 :141,002,003,169,149,141,115
38172 :003,003,076,162,164,165,089
38178 :251,141,002,003,165,252,080
38184 :141,003,003,076,049,158,214
38190 :076,203,147,132,020,133,245
38196 :021,032,019,166,096,032,162
38202 :146,145,132,251,133,252,093
38208 :032,146,145,132,253,133,137
38214 :254,032,184,149,076,116,113
38220 :149,032,060,145,056,165,171
38226 :253,229,251,165,254,229,183
38232 :252,176,010,173,028,144,103
38238 :201,001,208,003,076,055,126
38244 :158,238,028,144,173,028,101
38250 :144,201,006,208,005,169,071
38256 :001,032,147,149,173,028,130
38262 :144,010,010,024,105,008,163
38268 :133,211,160,000,177,251,032
38274 :032,210,149,169,058,032,012
38280 :210,255,230,251,208,002,012
38286 :230,252,076,077,149,169,071
38292 :058,032,210,255,169,018,122
38298 :032,210,255,198,252,160,237
38304 :250,177,251,201,032,144,191
38310 :007,201,127,176,003,076,244
38316 :176,149,169,046,032,210,186
38322 :255,200,208,235,230,252,022
38328 :032,033,159,169,032,032,129
38334 :210,255,165,252,166,251,209
38340 :032,205,189,169,000,141,164
38346 :028,144,169,062,032,210,079
38352 :255,096,168,032,162,179,076
38358 :032,221,189,160,255,200,247
38364 :185,000,001,208,250,140,236
38370 :023,144,136,136,136,185,218
38376 :000,001,201,049,144,007,122
38382 :201,058,176,003,076,247,231
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38388 :149,169,048,032,210,255,083
38394 :200,204,023,144,208,231,236
38400 :096,032,083,228,000,169,096
38406 :000,141,017,144,133,180,109
38412 :240,020,169,000,141,017,087
38418 :144,169,001,133,180,208,085
38424 :009,169,001,141,017,144,249
38430 :169,000,133,180,032,146,178
38436 :145,172,029,144,169,000,183
38442 :153,003,002,136,177,034,035
38448 :153,003,002,136,016,248,094
38454 :173,017,144,208,011,160,255
38460 :002,185,084,151,153,000,123
38466 :002,136,016,247,169,015,139
38472 :162,008,160,015,032,186,123
38478 :255,032,137,145,152,174,205
38484 :017,144,240,009,056,233,015
38490 :003,162,003,160,002,208,116
38496 :004,162,000,160,002,032,200
38502 :189,255,032,192,255,144,145
38508 :003,076,090,144,169,015,093
38514 :032,195,255,165,180,240,157
38520 :028,169,003,162,008,160,138
38526 :003,032,186,255,173,029,036
38532 :144,162,003,160,002,032,123
38538 :189,255,169,043,166,045,237
38544 :164,046,032,216,255,032,121
38550 :080,145,076,055,158,160,056
38556 :001,152,145,043,032,051,068
38562 :165,076,049,158,032,146,020
38568 :145,176,050,132,251,133,031
38574 :252,072,169,036,032,210,177
38580 :255,104,032,192,150,152,041
38586 :032,192,150,076,240,150,002
38592 :072,074,074,074,074,032,080
38598 :207,150,104,041,015,032,235
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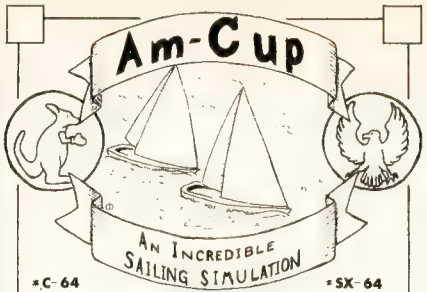

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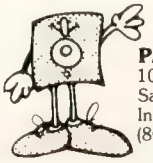

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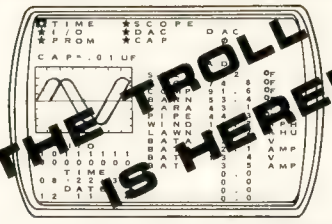

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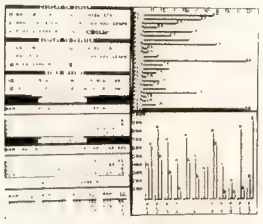

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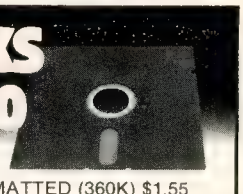

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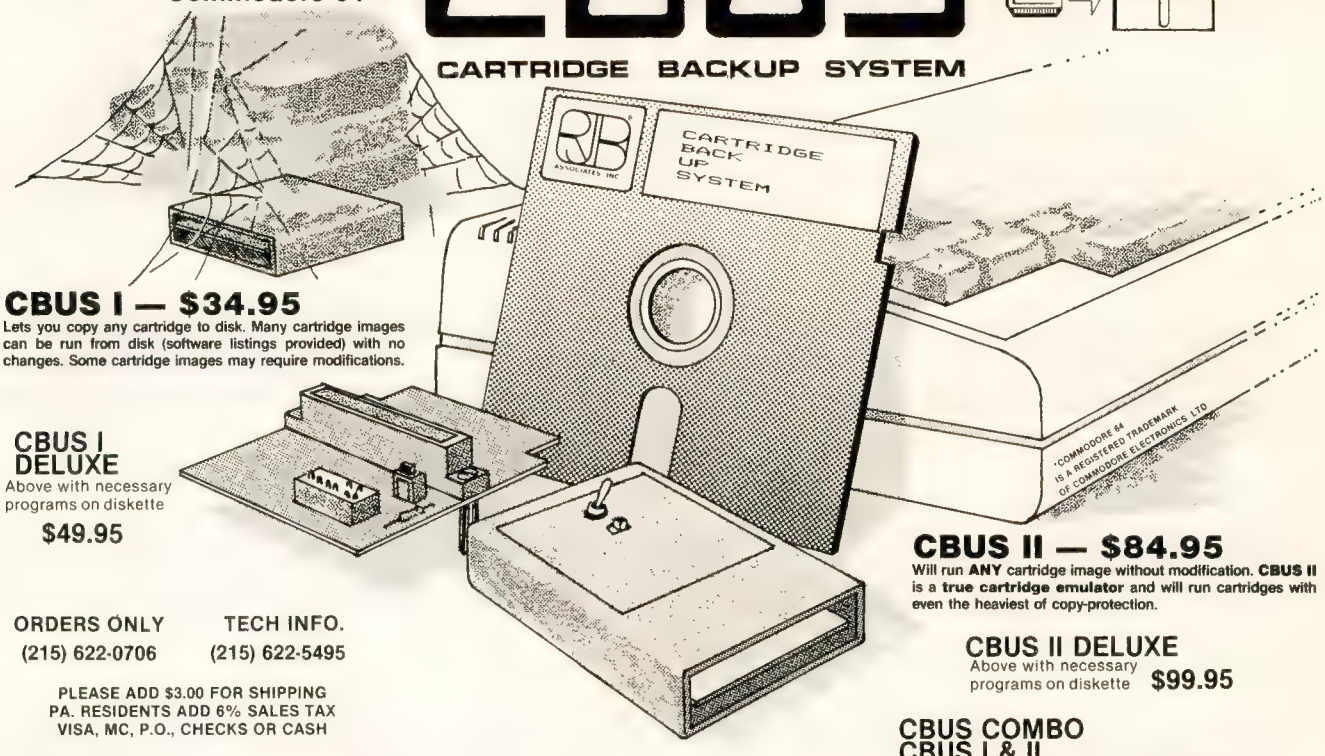

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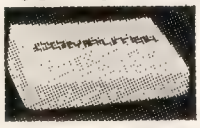

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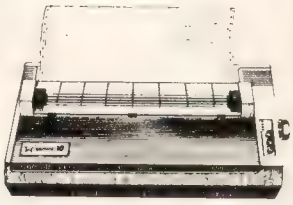

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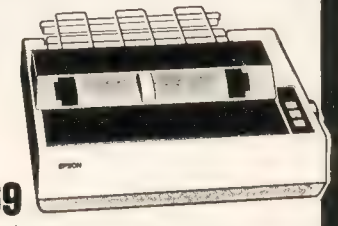

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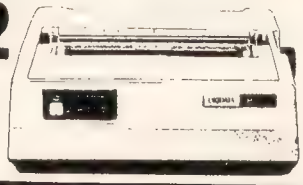

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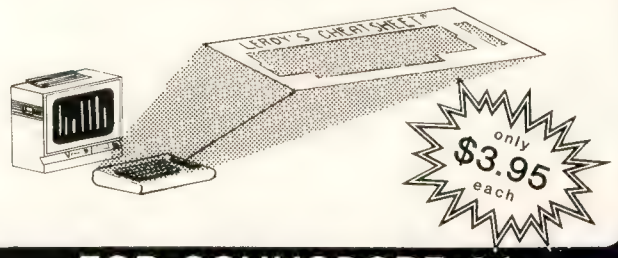

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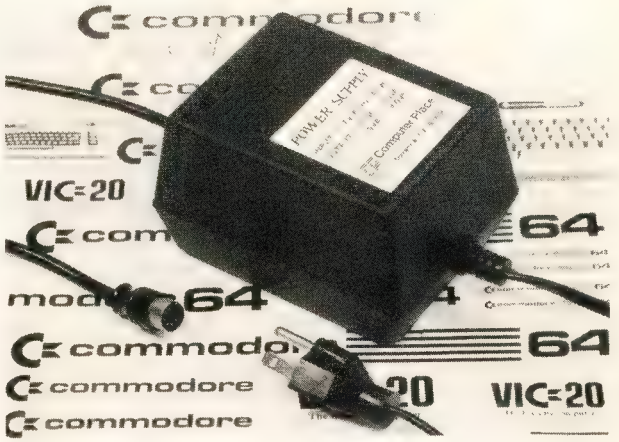

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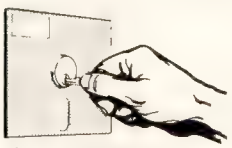

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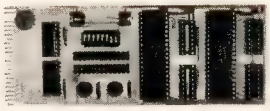

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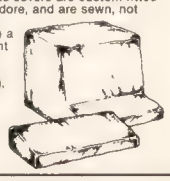

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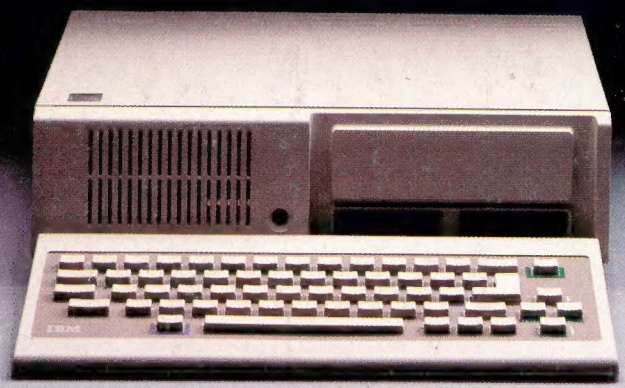

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